CULTIVATED EVERGREENS

EDITED BY L. H. BAILEY

THE CULTIVATED EVERGREENS

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PLATE I. A group of old field-pines; hemlock spruce in the distance at the right

THE CULTIVATED EVERGREENS

A HANDBOOK OF THE CONIFEROUS AND MOST IMPORTANT BROAD-LEAVED EVERGREENS PLANTED FOR ORNAMENT IN THE UNITED STATES AND CANADA

EDITED BY

L. H. BAILEY

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EDITOR'S PREFACE

TO MAKE a book of the cultivated evergreens requires that experts be consulted. The present volume is, therefore, a compilation of articles written by several persons, on a projected plan, brought together and edited in one office. Those familiar with these subjects will recognize the names and appreciate the value of their contributions: Ralph S. Hosmer, Professor of Forestry and head of the Department of Forestry, New York State College of Agriculture, Cornell University; O. C. Simonds, landscape-gardener and author of the book, "Landscape-Gardening"; John Dunbar, Assistant Superintendent of Parks and Arboriculturist, Rochester, N. Y.; George P. Brett, president of The Macmillan Company, interested in the planting of evergreens on his estate in Connecticut; Henry Hicks, nurseryman on Long Island; Frederick Ahrens, propagator, Park Department, Rochester, N. Y., and long engaged in the same work with the old firm of Ellwanger & Barry; E. Bollinger, of the Robert Douglas' Evergreen Nurseries in Illinois; W. T. Macoun, Dominion Horticulturist, Ottawa, Canada; Ernest Braunton, horticulturist in southern California; C. R. Crosby, Professor of Extension Entomology, New York State College of Agriculture, Cornell University; J. B. Palmer, Instructor in Entomology, New York State College of Agriculture, Cornell University; F. Dickson, Instructor in Plant Pathology, New York State College of Agriculture, Cornell University; Alfred Rehder, of the Arnold Arboretum of Harvard University, author of many contributions on the botany of woody plants; Frederick V. Coville, Botanist, United States Department of Agriculture, who has given special attention to the

cultivation of certain ericaceous plants; Ralph W. Curtis, Professor of Ornamental Horticulture, New York State College of Agriculture, Cornell University.

The subject of evergreens possesses no close cohesion, although it is recognized as a department of knowledge and practice in horticultural usage. The subject suggests coniferous plants, and these are the ones here chiefly intended. The reader must understand that the phrase "coniferous plants," or Coniferæ, as currently used, includes other species than those that bear true cones; some of them, as junipers and yews, yield soft berry-like fruits. These plants agree in certain essential floral or sexual characters, rather than merely in the fact of bearing cones, as also in anatomical structure and evolutionary history; they are properly known as gymnosperms.

In the northern part of the country there are no evergreen trees aside from the gymnosperms, but there are a good number of broad-leaved non-deciduous species of the stature of shrubs and subshrubs. The more prominent of these plants are covered in the book. They are mostly "flowering evergreens," being attractive by their blossoms as well as by their foliage; these are various heaths, rhododendrons, laurels, and their kin, and honeysuckles. Others are typically "berry evergreens," as hollies, cherry-laurels, viburnums, cotoneaster, and pyracantha.

It is fifty-five years since "The Book of Evergreens," by Josiah Hoopes, nurseryman and "member of the Academy of Natural Sciences of Philadelphia," was published in New York. It was long indispensable. A half century has brought us into a new atmosphere. The list of evergreens now has many names strange to that day. The knowledge of insects has vastly increased; and the science of plant pathology has come into being. In those days the best that could be said

of one of the most "mysterious causes of death in the Coniferæ," the blight, was this sentence: "The most rational cause that we can assign for the appearance of blight in the family of Conifers, is that due to a too luxuriant growth." If we complain of the difficulties in these days, we are also to remember that our resources are great and our hope should be controlling. We should like to know what particular shortcoming is ours, as it will be adjudged in the years to come.

We need a book on the horticultural evergreens, with results of careful experience. The Editor hopes that this volume will be useful.

The interest in evergreens, particularly in the more durable conifers, is a subject particularly suited to the substantial amateur. The slowness and regularity of growth, the abiding quality in the round of the twelve months, the element of stability in these plants, appeal strongly to the person who has arrived at a settled purpose in life, who has an estate to develop, and whose sentiments are established. We easily reflect our human qualities into them. There is no haste in their nature, no radical change of purpose in their character. They have a strong juvenile habit and quality, and then they age gradually into a picturesque maturity, each one with outstanding individuality. They are not unduly elated over the advent of spring; they are patient in the adversity of midsummer; they withstand the buffet of winter. They cover the margins of the landscapes and inclose the property securely, giving it a serene atmosphere. They typify the strength of strong men and women as they grow old with the advancing years.

The love of the conifers is no passing fancy. It is not subject to change in fashions. What a man plants today will give him joy as long as he lives, and the trees will carry his memory to his children's children; "he shall grow like a cedar in Lebanon."

When you travel over roads in the wooded hills you come now and then to an opening margined with evergreens. You stop, and enter the place with reverence. You feel a mystery in it. Instinctively you expect strange bird-notes. You sit on a mound, in a quiet reflective mood. You note that some one has built a cooking-fire in the place; the stones still show the marks, and ends of old embers are left. You see evidences that others beside yourself have worshipped there; this gives the spot a human interest. You want to transport this quiet retreat to your own estate.

But perhaps you have no extensive premises to develop. Yet you are interested in the trees you see here and there. You would plant two or three trees in your small area, hoping that they may attain something of the character you see in the wood. They will aid to give your enclosure seclusion. They will provide greenery in the winter. You will note how they respond to the changing seasons, being interested all the more, perhaps, because the response is not violent. The interest does not inhere in showy and transient bloom. The soft growth of the spring shoots is as good to you as flowers. Indeed, few flowers are more beautiful than the annual tender new growth of several of the firs and many of the spruces.

Or perhaps you have only a small city space unadapted to evergreens, or even no land at all. In that case, the range of the native evergreen landscape is yours to explore and enjoy as you will; and you will want to know the kinds, that your appreciation may have direction.

Although to the unpractised eye most evergreens look alike, yet there are clear distinctions in leaves, and the identification of them cultivates the discriminating faculties. The cones and berries are a never-failing source of interest. Specially so are the seed-bearing cones of pines and spruces and the other true

conifers, unlike the fruits of other kinds of plants. In pines, the cones do not mature till the second or even the third year, and in some species they persist till the enlarging limb grows them into the solid wood. This deliberate and durable quality is quite in keeping with the character of the tree itself. These cones are of comely shape, so much so that from early times they have been used as suggestion in the forms of art, and the shape has become an inheritance in literature.

The planter's interest in evergreens is of two kinds—to grow a collection of different genera and species, to incorporate them as parts in a landscape picture. These two purposes are often in conflict, although either one is legitimate. The happiest result is no doubt a thoughtful combination of the two efforts, unless one desires to make only an arboretum; and yet the arboretum may itself have an artistic quality.

L. H. BAILEY.

Ithaca, N. Y., May 1, 1923.

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The photographs in this book are from many sources, largely the Arnold Arboretum, Boston; some are from the Hunnewell estate, Wellesley, Massachusetts; a few are trees belonging to Mrs. W. Bayard Cutting, on Long Island; Plate V is from a photograph by Mattie Edwards Hewitt; others, of small trees, are from Mr. Brett's plantation in Connecticut. Other plates are from scattered sources. The engravings of the species, in the text, all prepared for this book, are mostly made from materials supplied by the Arnold Arboretum.

PART I

THE PLACE AND CARE OF CONIFEROUS (GYMNOSPERMOUS) EVERGREENS GROWN FOR ORNAMENT

PLATE II. A study in horizontality.—Group of piceas

THE CULTIVATED EVERGREENS

CHAPTER I

THE CONIFEROUS EVERGREENS IN THE LANDSCAPE

AN EVERGREEN is a plant that holds its green foliage when dormant. It is the prevailing opinion, no doubt, that an evergreen plant is one that is always green; but all plants are so colored in the growing state, and one that grows year in and year out is necessarily continuously green. In this sense, palms are evergreens; so are meadow and lawn grasses when winters are mild; and so are begonias and tomatoes when cold does not kill them. The true evergreen, however, is the one that remains verdant even though it is not growing, and in spite of winter or frequent frost. It is not deciduous; and, moreover, its foliage remains green rather than brown and sere.

The representative evergreens are the conifers, although not all conifers are evergreen. Some of them are deciduous, as the bald cypress and larches. The conifers, or Coniferæ, comprise a mighty group in the vegetable community, agreeing not primarily in the fact that so many of them are evergreen, but in certain clear botanical structure as explained in Part II. They yield great products for the use of man in timber and resins; and their ornamental value is outstanding. They may well be treated as a unit, either from the forestry side or from the horticultural use. The latter utility is intended in this book; but it is first important to appreciate the coniferous forest, against which so much of our civilization is set.

Appreciation of the forest is essential to the best under-

standing of evergreens. The forest is their natural habitat. In the open, the trees attain a different character, to be sure, and this character is to be assumed as the one natural to the species; yet the forest has a community character of its own and illustrates the features of close plantation as compared with isolated trees. Both of these adaptabilities of the species should be understood. Moreover, the forest has a place in the association of the human race that must not be overlooked; and in these later times, when the great forests are constantly receding, we should make a special effort to keep green the memory of the woods.

THE BACKGROUND OF THE FOREST.—Hosmer

Among all the trees of the forest, the conifers are the most important from a commercial standpoint. The reason for this is not far to seek. The trees belonging to the coniferous genera —the pines, spruces, firs, cedars, and hemlocks—furnish the material most in demand for construction of all kinds, and also for a great variety of minor uses in which the demand is for strength combined with relative lightness. The so-called "softwoods" are more easily worked and usually are cheaper than are the broad-leaf species, or "hardwoods," at least in the grades suitable for building purposes. It is not strange, then, that in considering the direct economic value of the forests of the United States, those in which conifers predominate are given first place.

Forests are of use to man in three principal ways: They supply timber, wood, and other forest products. They safeguard the catchment basins of streams needed for human use and so tend to maintain regularity of stream-flow. Also they serve as centers for many forms of recreation. Forests have a direct relation to human health. This is most noticeable in the

case of coniferous forests. Highly beneficial results often attend a sojourn in a locality in which there are pine or spruce forests. Forest sanatoria, such as those established by the states of New York and Pennsylvania, are usually in sections in which the conifers predominate.

From the standpoint of timber supply, the coniferous species furnish approximately seventy per cent of the timber cut each year in the forests of the United States. Of minor uses, fifty per cent of the box material comes from the two main divisions of the pine family—the white and the yellow pines. Spruce is the best material for the cheap production of paper. In the southern states, long-leaf pine is the chief source of turpentine and naval stores. The uses are manifold to which the wood of the conifers is put. Wood, and, in large part, coniferous wood, is at the foundation of the prosperity of the nation.

The coniferous forests of the United States form a part of the great belt of conifers that characterizes the North Temperate Zone. This belt stretches from Alaska across Canada and the United States and is found again in Scandinavia, northern Europe, Russia, and Siberia. In the United States, coniferous species are the commercially important trees in four of the five natural forest regions: the Northern Forest, the Southern Pineries, the Rocky Mountain, and the Pacific forests. The fifth region is that of the Central Hardwoods.

The Northern Forest includes the North Woods of New England and New York, the pine lands of the Lake States, and the area lying at the higher elevations southward along the Appalachian Mountain ranges. The more important conifers of the Northern Forest are white pine (*Pinus Strobus*), red pine (*P. resinosa*), red spruce (*Picea rubra*), hemlock (*Tsuga canadensis*), and cedar (*Thuja occidentalis*). Although at the higher elevations there are pure stands of conifers, the typical

Northern Forest is a mixed forest of conifers and broad-leaf trees. White pine is, or was, the outstanding species. Its tall bole, large size, and easily worked wood marked it from colonial times as, perhaps, the most prized American timber tree. The original forest has now disappeared, except for a few small isolated stands. However, white pine reproduces easily, both naturally and artificially, and grows rapidly, so that in the Northeast it has come to be the principal species used in reforestation.

The Southern Pineries, as the name implies, is essentially a coniferous forest. It extends along the Atlantic seaboard from New Jersey southward to the Gulf States. Long-leaf pine (*Pinus palustris*) is the tree of first importance, both for its lumber and for its turpentine. Three other pines are also to be noted: short-leaf (*P. echinata*), loblolly (*P. Tæda*), and Cuban or slash pine (*P. caribæa*). In the swamps of the South is found the bald-cypress (*Taxodium distichum*).

In the Rocky Mountain region the species of commercial importance are the western yellow pine (*P. ponderosa*), lodge-pole pine (*P. contorta* var. *latifolia*), Engelmann spruce (*Picea Engelmanni*), and the mountain form of Douglas fir (*Pseudotsuga taxifolia*). In the "Inland Empire" of Montana and Idaho, the western white pine (*P. monticola*) is an important timber tree. Regulated grazing plays an important rôle in the national forests in this region.

The Pacific forest comprises the Pacific Coast states. In Washington and Oregon the most important trees are Douglas fir, western hemlock (*Tsuga heterophylla*), several true firs (Abies), western red-cedar (*Thuja plicata*), Sitka spruce (*Picea sitchensis*), and western white pine. In California the species that stand out are redwood (*Sequoia sempervirens*) near the coast, sugar pine (*Pinus Lambertiana*), and western yellow pine

in the Sierras. The largest and highest, as well as the oldest trees in the world, the "big trees" (*Sequoia gigantea*), are found on the Pacific slope.

The foregoing list enumerates but a few, of course, of the total number of conifers in the several forest regions. In general, the forests of the United States fall into two main classes, the eastern and western forests. East of the Great Plains, broad-leaf species are found in mixture with conifers. There is usually much undergrowth. In the West the forests consist of practically pure stands of conifers, for the most part, except in the Pacific Northwest, of open character and free from undergrowth.

Without the lumber yielded by the coniferous forests, the United States could never have achieved the rapid material progress that has characterized the growth of the nation, especially since the Civil War. The rapid expansion of the Mississippi Valley States was made possible in no small part by the pine forests of Michigan, Wisconsin, and Minnesota. Likewise, southern pine has played a great part, just as now Douglas fir is coming to be one of the most used woods. The coniferous forests have been a great heritage, but, unfortunately, they have been misused and until very recent years no thought has been given to their replacement. The forest has been treated as a mine, not as a crop. The American people will have reason to regret their short-sightedness.

The Pacific Coast forests now constitute the last great storehouse of virgin softwood timber. When that supply is exhausted, the needs of the nation can be met only from second-growth forests. Furthermore, four-fifths of the standing timber that remains is privately owned and as yet but little of this area has been brought under scientific forest management. This gives point to the movement for an adequate national

forest policy that aims to bring about the wise use of all forests, both publicly and privately owned, to the end that the people of the United States may have a continuous supply of wood and of other forest products, adequate for their needs, in perpetuity.

THE CHRISTMAS-TREE PROBLEM.—Hosmer

Of all that the forest yields to man, perhaps no gift is more prized than is the Christmas tree. To the children the tree, with its gay decorations, its glittering lights, and at the top the bright star, is the center of the Christmas celebration. To their elders it brings but little less pleasure. In many families the Christmas tree is allowed to stand for a week, or even until Twelfth Night, all the while continuing to give joy to young and old. It is an indispensable part of the happy Christmas-tide, and, even when dismantled, it may still serve out-of-doors as a feeding station for the birds. Without a tree the Christmas festivities are not complete.

Just how far back in history the Christmas-tree custom goes, no one knows. It is probably of very ancient origin, possibly a survival from the Scandinavian mythology that preceded Christian times. But whatever its origin, the custom is now so wide-spread and deep seated that it has a recognized place in every Christian country. The United States leads the world in the use of Christmas trees. Over five million trees are needed each year to supply the demand in American homes. The following statement is designed to show that the use of trees for this purpose is a legitimate and, if properly conducted, a wise use, and that the purveying of Christmas trees rests on a basis of sound economics as well as on sentiment.

Many different kinds of trees are used in the United States as Christmas trees, but practically all are conifers. In the

Northeast the favorite is the balsam fir. This comes near to being the ideal Christmas tree. As a small tree it is usually symmetrical, with long, horizontal, spreading branches. Its needles are pleasantly fragrant and persist indoors longer than do those of most other evergreens. Spruce comes next in importance and makes a very good substitute for balsam fir. The species most employed is the red spruce, but the introduced Norway spruce is also to be commended. The other native species, the black and the white spruces, are also used.

In the Southern and Central States red-cedar is often used as a Christmas tree. It has a conical form and develops a dense and attractive crown. Where the firs and spruces are not easily obtainable, pines are not despised. In parts of the South the scrub pine is much in demand. In the southern Appalachians, Fraser fir makes a good Christmas tree.

In the Rocky Mountain States, Douglas fir, Engelmann spruce, and, in places, lodge-pole pine find favor; on the Pacific Coast, white fir, incense-cedar, and western hemlock. Local custom and availability have much to do with the kinds and species which are used as Christmas trees. Santa Claus seems as well satisfied with one kind as another.

Northern New England, northern New York, and Canada are the source of supply for the cities of the Atlantic seaboard as far south as Baltimore and even Washington. Michigan, Wisconsin, and Minnesota furnish the markets of Chicago, St. Paul, and the cities of the Plains States. The arrival of the "Christmas tree ship" is a looked-for event in Chicago harbor.

Christmas trees vary in size from three to five feet up to thirty-five feet or more. The small sizes up to eight to ten feet are tied in bundles. Large trees are shipped as individuals. Prices in the eastern city markets range from twenty-five to fifty cents up to $40 or $50, but as the Christmas-tree trade is

now conducted, the owners of the land from which the trees are cut seldom make much profit. When carload lots are shipped, particularly if the trees are graded as to size and condition, the returns may be worth while. There is, however, considerable risk in the Christmas-tree business, especially when a local market is overstocked. Each year after Christmas many perfectly good trees are hauled to the city dump to be burned. To be assured of a reasonable return, the rational procedure for the Christmas-tree owner is to find a market in a neighboring town or city and supply the retail stores directly. By this method he will probably gain much more than when the trees are handled by a series of middlemen.

Very commonly the question is raised as to whether the cutting and use of Christmas trees is not a great waste, and whether steps should not be taken to discourage or prohibit it. In the opinion of the United States Department of Agriculture, the custom is so old, so well grounded, and so venerated, that even if it were economically somewhat indefensible, these aspects would and should continue to outweigh economic considerations. But, say the foresters, the cutting of trees for Christmas is proper and wholly justifiable. No other use to which these trees could be put is any more worthy than to make them add to the joy of mankind through their use by children on this great festival of the year. True conservation of the forest is not found in abstaining from the use of trees, but in a rational system of forest management. The Christmas tree is a legitimate by-product of the forest. If the spruce and fir trees that are so used were left standing, to be cut later for the manufacture of paper pulp, it is wholly pertinent to inquire whether the joy of a group of children in their Christmas tree does not outbalance the value of a page or two of the comic section of a Sunday supplement.

There are two ways by which Christmas trees can be supplied to meet the demand. Both are in perfect accord with the best principles and practices of forestry. One is by means of intermediate or improvement cuttings, whereby the value and quality of a given stand of forest can be bettered; the other is through the establishment of Christmas-tree plantations, where firs or spruces are grown for this special purpose.

At present the larger number of Christmas trees, both in the United States and Canada, are cut on privately owned lands. Many farmers take advantage of the opportunity thus afforded to clean up pastures where the forest is starting to come back, or to clear land that should be kept open. In parts of New England and in other regions where it is the desire of the owner that abandoned pastures should revert to forest, the taking out of small trees, especially balsam fir, may be of distinct advantage to the stand. The practice of making thinnings is, when judiciously applied, an integral part of forest management. The demand for Christmas trees often makes it possible for the owner to sell the trees removed at a price sufficient to cover the cost of such thinnings, if indeed he does not make an actual profit. Small trees of the coniferous genera have little value for other purposes. Comparatively few owners feel that they can afford to make thinnings which require an outlay for labor, without some immediate return. The indiscriminate clearing of any area of forest land, without making adequate provision for its restocking by young growth is, of course, to be discouraged. True conservation of the forest is its perpetuation through wise use.

The other method, that of establishing commercial plantations of Christmas trees, is already attracting the attention of many owners of non-agricultural land. As the trees are to be removed while still small, close spacing is indicated; three by

three feet is good. A rectangular spacing of three feet requires 4,840 trees to the acre. With a triangular spacing of three feet between trees each way, the number is 5,584 to the acre. In New York State, spruce transplants, four years old, can normally be obtained from the nurseries of the Conservation Commission, Albany, for around $4 a thousand. In other states that maintain state nurseries, a similar arrangement usually obtains. Specific information may be obtained by addressing the State Forester. Directions as to how to plant the trees may also be secured from the State Forester, or from the State College of Agriculture. To give such assistance is a part of the duty of these state officers.

In a Christmas-tree plantation made by the Department of Forestry of the Michigan Agricultural College, where four-year-old Norway spruce transplants were used, the average height of the trees in the plantation was six feet at the end of six years. A few of the best trees averaged nine and one-half feet for this period. The soil was a stiff clay, full of stones, and wet in the spring. It was found "that if the trees grow faster than one foot a year they become spindly. The best Christmas trees are those which have grown rather slowly. They are bushier and better shaped."* From such a plantation some trees are cut each year, giving those left a better chance to develop.

A careful estimate of possible returns from Christmas-tree plantations in New York State, made in 1919 by G. Harris Collingwood, Extension Specialist in Forestry at Cornell University,† showed for a ten-year period an expected net annual profit of $68 an acre. Costs of nursery stock and of

*Mich. Agr. Coll. Exp. Sta. Special Bull. No. 78. Apr. 1916. "Christmas Tree Plantations," by A. K. Chittenden.

†Two articles in the *Rural New Yorker*, Mar. 1 and 8, 1919. "Christmas Tree Farming," by G. Harris Collingwood.

planting, the value of the land, and taxes were all counted in and carried forward at six per cent compound interest. This figure should be taken only as a general indication of the money return to be expected, but it points to the conclusion that when the local conditions are favorable, the growing of Christmas trees can be made a profitable commercial venture.

In growing Christmas trees, it should always be borne in mind that the most important item is to be sure that there exists a market, preferably not far distant, where it is reasonably certain that the trees can be sold when they are of the right size. Where this condition obtains, the establishment of a Christmas-tree plantation should not only be a good investment, but, also, to an owner with imagination, a very satisfying way of using a part of his land.

THE NATURAL SETTING OF EVERGREENS.—Simonds

In landscape work, Nature is the best teacher in the use of evergreens as well as that of other growth. In visiting localities in which evergreens thrive, one is usually impressed with their beauty and wishes to have them about one's own home. The effects that should be studied are often found at the edges of a forest, or scattered along river-banks and margins of lakes and marshes. Here trees may range in size from less than a foot in height to those of large stature. The growth may include pines, spruces, cedars, balsams, hemlocks, junipers, and yews in the northern Middle States, and, in the Eastern States, broad-leaved evergreens as well. In the Middle West the more hardy conifers can generally be used with good effect where soil conditions are right and the air pure, but in the larger cities, with their smoky atmosphere, it is useless to plant any member of the pine family. Sometime in the future, when cities can be delivered from the pall of smoke that hangs over them, they

may be able to raise evergreens. At present, however, conifers planted in a smoky atmosphere are likely to look sickly and to excite feelings of pity rather than of pleasure.

Attention might be called to some attractive natural effects. At the edges of pine forests, or scattered about in open spaces near the edge, the pines and other evergreens often retain all their branches, the lower ones resting on the ground and reaching out farther than those above to secure light and air. These show the typical appearance which pines, spruces, firs, hemlocks, and cedars should have in one's home grounds or in other places where they are planted for ornament. Sometimes a belt of evergreen growth may be useful as well as ornamental by giving protection from cold winds, or shutting out of view unsightly objects. In such belts it is well to arrange the trees in colonies, pines being grouped with pines, and the more pointed and stiff-growing trees, like the spruces, with those of similar habit. It is said that evergreens should not be mixed or grouped with deciduous trees. To a certain extent this is true, but all will recall the beauty of autumn foliage, especially that of the maples, sumacs, birches, and blueberries, when this beauty is heightened by a background or a neighboring group of evergreens. A ground-covering of spreading junipers or yews frequently adds much to the artistic effect of the upright growth. Indeed, when the grounds are not very large, it may be well to fill nearly all of the open space with a low growth of this kind. Evergreens are beautiful throughout the entire year and especially so in winter when partly covered with snow and in spring when the new growth comes out and is contrasted in color with the old, and when the trees are thickly sprinkled with beautifully colored blossoms, the pistillate flowers often a rich red or purple, the staminate a bright yellow.

The principles of landscape-gardening which apply to the arrangement of plantations, the preservation of ample open space, and the natural irregular arrangement which gives such a charm to woods, apply to evergreens as well as to oaks, maples, and hawthorns. In using evergreens they should first be considered as objects of beauty in themselves; then as backgrounds for roses, elderberries, or other low growth that flourishes in the neighborhood, or as a foil to other plants. Yellow birches and hemlocks are often found growing near each other and seem to adjust their branches without much interference. A hillside covered with pines and bordered here and there at the bottom with Carolina roses, red-branched dogwoods, snowberries or viburnums, often gives a pleasing effect. A birch tree with its white bark shooting above the growth of roses or dogwoods may contribute to the charm of the whole composition.

Evergreens form an important part of that wealth of plant-life from which the landscaper must choose the material with which he makes his most effective compositions. They can be used with greatest safety for marginal planting, or as groups located near the margins of open spaces, near buildings, or on promontories or hillsides. When planted near the summit of a ridge or a hill, they emphasize more than other trees its effect of height.

EVERGREENS IN THE PLANTED LANDSCAPE.—Hamblin

In temperate regions, most of the evergreen trees are conifers, and also the greater number of ornamental evergreen shrubs of wide use in planting are dwarf conifers. The broad-leaved evergreens, as members of the heath and holly families, are of less universal use than the conifers, and the study of their effective grouping will follow the more important dis-

cussion of the placing of evergreen conifers. Although entirely different in foliage texture and cultural requirements, the problems of their use in landscape composition have many points in common.

Evergreens should be placed much more thoughtfully than deciduous trees and shrubs. The mere fact that they are more costly than deciduous woody plants, and more difficult to grow, puts them in a class by themselves. Yet even if they were cheap and easy to keep in good condition, they would still be very distinct and would need to be placed with care in regions in which the leaves fall from most plants in autumn. Evergreens are so very definite in their habit, texture, and color that each specimen counts very distinctly, and when planted carelessly in small areas give a very spotty appearance.

Evergreens are the same in the landscape at all seasons of the year. Although the common trees and shrubs run a yearly cycle from leafless twig to leaf, flower, and fruit, the evergreens, descendants from an earlier plant era, go through the seasons with little modification save the fresher green of the new shoots in May. The changes of growth and decay are theirs, but after they are planted their chief change is increase in size.

In winter months, contrasted with the white of snow and gray of leafless twigs, the dark greens of the conifers suggest warmth and cheer to man. Even beast and bird find shelter in spruce and pine in cold weather. This physical fact contributes greatly to our joy in their sight in winter. In summer, their heavier darker greens, against the broad paler leafage of deciduous trees, suggest shade and coolness. Under the hemlock branches in August it is cool and damp, and the sights and sounds of midsummer are mostly absent. Their suggestion of physical comfort, at both extremes of the year, make evergreens particularly desirable near the dwellings of man. How-

ever, these factors do not render easier the problem of effective planting.

A study of the characteristics of coniferous evergreens from the point of view of art, the art of arranging them in landscape pictures, shows them full of contrasts. Although the foliage is small and narrow, it is so dense that the effect is not feathery, but heavy and solid. There is great difference between the texture effect of tamarix and cedar, yet the latter has the finer foliage. Only the pale greens of the deciduous conifers (larch and bald-cypress) and extreme forms of some chamæcyparis give a light touch to the picture. The density of the dark foliage is increased by the regular formal outline of most species and the regular structure in the placing of the branches. There is no more unrelated object on a peaceful lawn than a blue spruce, and two are twice as lonesome. The more irregular the outline and broken the branching, the easier the task of grouping, except for special effects. The dense, tense attitude of most conifers makes them difficult subjects to handle. If only they could be dented inwards in places, and pulled out in others, they would be much more companionable among their fellows. Each specimen is so complete and perfect in itself that only when old age has robbed it of its symmetry does it become a subject for consideration as an object of art in the landscape.

In color, the normal dark shining green shows less range than do the greens of deciduous trees. Their color value to the camera is much the same in all species. Gray-greens in pine, blue-greens in spruce and fir, white lines on the under side of fir and hemlock leaves, give variety in detail that can be appreciated only at close hand. Unfortunately, freak colors are found in horticultural varieties in a range more than sufficient. Intense blue, bright yellow, pale silvery green, and

bronzy purple are possible in many of the conifers, particularly in the smaller species. Pine and hemlock have mostly refused to depart from their normal foliage. In general, the farther the color of a conifer has ranged from a normal dark green, the less it should be planted in home pictures and the more care must be used in its disposition, when it is permitted, for it is always a special and striking object at all seasons.

By their density of twig and foliage throughout the year, evergreens offer ideal protection from wind and storm, as windbreak, shelter, and screen. A very effective shelter-belt can be made by a narrow strip of evergreens. Since conifers are a very heavy mass when grouped, this windbreak must also be a part of the landscape picture, and when used for a screen they will call attention in the direction toward which the view is to be shut off. Their double service of attracting as well as protecting must ever be borne in mind. The dividing planting must then be ornamental also. The best hedges are of evergreen conifers.

Evergreens of all kinds give a feeling of richness to the cultivated landscape, possibly in part because they are expensive and at times difficult to cultivate to perfection. As foliage plants they have come to be considered as the most beautiful and choice of woody plants. They may be sadly out of place, as seen in some small yard, or badly broken by insects and the elements because of lack of care, yet there is a special halo of inherent virtue around each one of them. The same is true in regard to a natural planting of conifers. Whatever the arrangement given them by nature, as a group they are pleasing and add tremendously to the beauty of that particular spot.

As Nature puts out her spruces, firs, pines, and cedars, her pictures are always pleasing, and analysis of their arrangement shows how great advantage was taken of every change in soil

PLATE III. A study in perpendicularity.—Red-cedar (*Juniperus virginiana*)

PLATE IV. Combination of yew and pine.—Japanese yew (*Taxus cuspidata*) as a border; white pine (*Pinus Strobus*) at the back

and exposure. When man plants conifers to dress his scene, pictorial and nature-like compositions are rarely brought forth. A natural arbor-vitæ swamp has more to please the eye than the collections of conifers that wealth can put around its home. It is a far greater tax on the skill of the plantsman to set out a dozen conifers, even all of a kind, than the same number of mixed deciduous trees. A good artificial staging of conifers is rare; it is too easy to secure an assorted effect instead of harmony of line and outline. The use of conifers in sections of the country in which some species are native and common seems more happy and related to the site than their use in regions of few native trees.

It must always be borne in mind that, except for a few species and irregular old-age individuals, conifers present a firm fixed outline against the sky. They make individuals, not masses, and are numbered off by the eye, except when on the large scale of a forest. Spruce and fir, arbor-vitæ and red-cedar are clear-cut triangles and cones that will not lose their distinctive shapes unless planted together very closely. An array of

1. The vegetable solids of topiary work.

various genera and species becomes a demonstration in solid geometry. This fact is made use of and heightened by clipping, and the vegetable solids of topiary work are the extreme of this idea. (See Fig. 1.) Many unclipped evergreens, however, have a very complacent well-groomed appearance. Most pines, hemlocks, and Douglas spruce, and perhaps others, mingle their branches fairly well even in small groups. Even if their outline has a fairly close line relation, and although their foliage is similar to a marked degree in the genera, nevertheless their sharpness of outline and the individual characters of each make their mass formation a mixture and not a unified composition. It is advisable to have few species and fewer genera on display in any one section of a planting. The more numerous the species, the greater the diversity in skyline and composition.

The masses of conifers are darkest and densest of all vegetation; so also are their shadows very black on lawn or across structure or other vegetation. Coniferous evergreens are the deep tones in pictures out-of-doors. As contrast to structures, as background, low foreground, or horticultural adjunct, the shadows they cast have great pictorial value. Too many evergreens, because of depth of shadow, may make the picture too dark and dismal. Use of the lighter shades of green will help to offset this difficulty, as the selection of white pine instead of Norway spruce near a dwelling. Though the shadows may be as dark, they will be tempered by the lighter foliage color.

It is easy to see, therefore, that one evergreen in a planting may have more pictorial weight than any deciduous tree or several of them. Since its value in the picture is so great, its relation to the nearest vegetation is very important. In the grouping of the various conifers, avoiding the intense forms of color, any sorts that site and soil will allow to thrive may be

placed together with fair effect. The lack of conformity in outline seems the greatest problem. However, spruce and fir look alike to the camera, the triangles are all triangular; juniper and arbor-vitæ are equally exclamation points; pine, hemlock, and yew at length spread out similar wide arms; and the low dwarfs, as Mugho pine, dwarf juniper, and the Tom Thumbs make vegetable mattresses. There are, then, these four groups, and a massing within each group gives similarities of outline and structure; a choice from any two or more of these groups gives distinct contrasts.

In small areas one conifer can dominate the scene; or a group of a few can be the central feature of the planting. This means that the evergreen plant material should be chosen and placed first (on paper) and the attendant other vegetation is chosen to set it off by contrast of outline, structure, texture, color, size, and position. An equal mixture of evergreens and deciduous trees and shrubs is rarely satisfying. There is too much equality in bulk and the contrast loses value. For best pictorial effects, it is safest to keep the two types of vegetation quite or nearly apart and separated, except when definite differences of vegetation are desirable, and then the differences are strengthened by inequality of bulk and quantity.

One evergreen tree is well set off by a background of other similar or contrasting evergreens, but it is too obvious to show off well in good composition or contrast in front of a mass of deciduous trees. A small group of related conifers, a small unit in themselves, look much less lonesome against the larger area of deciduous background. They derive strength from one another and are less structurally unrelated to their contrasted vegetation.

Evergreens in mass formation make excellent backing to show off the special beauties of some tree—red maple in spring

bloom or autumn leaf, crab-apple in flower or fruit, golden stems of willow—for the main mass of the picture is the changeless composition of the evergreens, enlightened by the gift of the seasons from the deciduous tree or trees. Special plantings of all kinds—azaleas, lilacs, lilies, peonies, irises—acquire double value when inclosed and framed by perpetual walls of dark green. A small planting thus set off may have a quantity and quality that a larger one unframed, or seen against sky, cannot possess. After the brief period of bloom, the glory goes back to the evergreens, and the spot is full of beauty.

By nature all evergreens, except cedar of Lebanon, Japanese umbrella-pine, Monterey cypress, and a few similar relics of older eras, are forest trees somewhere. Most of them, however, are seen as landscape specimens, in solitary grandeur upon a lawn. For this special use their many virtues decidedly fit them, and when placed so as to bear some relation to other objects, their symmetrical sweep of branches renders them as complete in themselves as a Greek temple or statue. These conifers are, then, related to other objects, but not strictly grouped with anything, and when old age turns their symmetry into irregularity they have still a classic appeal.

Since their shape is so definite and permanent, coniferous evergreens are eminently suited to formal work of all kinds, and the size of material, from Tom Thumb arbor-vitæ to Austrian pine, can fit the scale of the design. The dignity and repose of a formal scheme is greatly increased by evergreen material, and the topiary art can assist nature. Here, again, the plants are not grouped, in the proper sense of the word, but are placed and spaced as the development of the design requires, living plants treated as geometrical forms, or solids for horticultural architecture. Since gardens were builded, evergreens have furnished the opaque solids.

PLATE V. A corner of mixed evergreens.—*Country Life Press,* Garden City, New York

PLATE VI. A fancier's collection.—Specimen plantings of junipers and yews

In the relation of the tree shape to the topography, rather definite suggestions may be secured from nature. Most spiry-topped trees grow naturally in hilly and uneven lands. Spruce, fir, and juniper seem to reach upward and emphasize the irregularities of the ground surface. Much more use could be made of this relation of shape of tree and soil surface in planting, each to bring out the special character of the other. One cannot think of New England's rocky fields without juniper or balsam, and the slopes of the Rockies without fir or spruce. Conversely, the planting of stately firs or pyramidal cypresses in open flat land, unless, as in Norway spruce, there is great lateral spread of lower limbs, seems particularly unhappy and inappropriate. In narrow spaces, shut in and separated from the flat expanse by buildings, walls, hedges, and other high planting, the spiry evergreens seem in fairly permanent quarters, but only as special contrast to site and surroundings. The spiry kinds are related to structures of all sorts—house, barn, or bridge—only by intense contrast.

Pines, nearly all sorts, offer the other extreme. Their lines in maturity are mostly horizontal, and the species frequent flat lands and the plains. They are more picturesque in age; the pine is one of the few conifers that grows old gracefully. To this group of horizontal type, with grace in age, can be added yew, cedar of Lebanon, some junipers, hemlocks, and probably Douglas spruce. These species are, thus, the most generally useful of large conifers. They fit all shapes of soil-surface, give level and regular lines against the sky, against structures and other solid masses, and mingle well in mass with one another, or with deciduous tree forms and foliage. More pines and cedars of Lebanon are needed in created landscapes, and not too many of the compact vegetable spires and cones, of which nature has created many in spruce and fir and juniper.

The shapes of these are too similar to make them distinct to the average eye.

The larger evergreens have their particular place in the landscape. Another special field is filled by the low species and dwarf forms of the larger sorts. For formal and pattern beds of all kinds, the low junipers, yews, arbor-vitæ and retinisporas were apparently created. Lacking these, and some of the broad-leaved evergreens, as box and English ivy, the contrast of lawn and normal vegetation, with dark masses of three dimensions in set designs, would not be possible, except as filled with herbaceous material. The plants are wholly restricted in their placing by the requirements of the design and the chief demand on them is that they live and thrive, yet increase in size but little lest they outgrow their allotted space and spoil the design. For the effect that Lord Bacon also observed in tarts, the regular ranging of this material has a decided place in certain styles of design. The chief requirement in the staging is a relation to some degree between the flat-topped, rounded, and pointed ones. To avoid monotony of forms or extreme diversity, securing harmony yet contrast in shapes, textures, and tones, requires an unusual degree of skill in placing plant materials.

The flat-topped and cushion-shaped forms of conifers, as dense varieties of spruce and arbor-vitæ, make very distinct groups in the landscape, so very distinct that they should be introduced with extreme caution in any except formal work. The spiry sorts, as Irish juniper or yew, are particularly useful as accents in the formal garden. The darkest forms, as savin and dwarf yew, give deep tones and shadows to this living painting; while the foliage tones of silver, gold, and blue add the high lights and sun touches. With such a wealth of material for this three-dimension sketching, the student of planting

wonders why so little use is made of this field, and so assorted the results achieved. Good staging of dwarf evergreens will make happy the home-lover and the nurseryman. Weeping and irregular dwarf conifers give picturesque and Japanese effects when properly placed for a special touch, but most ungainly forms look crazier than ever because of poor placing.

Irregular dwarf conifers, as the many forms of juniper and chamæcyparis, are excellent ground-cover in poor soil in the sun. For good land and under trees, the many forms of yew of low habit, and for moist soils the dwarf loose varieties of arbor-vitæ, take the place of grass or low deciduous shrubs, hiding soil and slope through the year. One species at a time, in soil that suits it, with some broad-leaved evergreen shrubs and perennials of good foliage, gives carpets of undulating green that no other planting can duplicate. No soil is too dry and sunny, shaded or damp, or the space too narrow, in regions where homes are built, to prevent the use of this richest of soil concealments. Small areas of definite outline, covered with dwarf evergreens in definite plan, make evergreen gardens that satisfy the eye the year through.

Evergreen conifers, therefore, contribute in the landscape picture the dark masses, the contrasts, the solid lines against the sky, shelter in hedge, screen, and windbreak, the solitary specimen, accents and adjuncts to garden accessories, the best material for formal work, and permanent cover to hold and hide the soil. Except such types as the pine, they are weakest as parts of harmonious composition, for their chief purpose is individual contrast, except in large plantations.

A special use in modern plantings for conifers of low or medium size (no trees) is for foundation and entrance plantings. To connect house walls with lawn and topography, something more permanent in appearance than salvia or deutzia is often

needed. The jumble of blue and Norway spruce, attended by golden juniper, which eventually die or become too big for the place, is seen from many a living-room window. Surely this kind of planting can be much better conceived, with a real unified relation to house and attendant objects. A few kinds, and not many of them, seem a safe rule for first attempts at this kind of planting. Plantings at entrances, doorways, street gate or portal of the garden, call for evergreen material. If the entrance is narrow, columnar junipers could be the main feature; when a feeling of space is desirable, Mugho pine and dwarf yew may mark the entrance. Good proportions in heights, diameters, textures, and colors suited to the type of gateway and their use seem to be the first requirement and often least considered.

In northern latitudes, the broad-leaved evergreens are mostly shrubs or woody herbs. Holly is, perhaps, the only broad-leaved evergreen tree, and its use is restricted by its needs. The chief difference in this type of plant material is its dissimilar foliage in size and texture. The flat, leathery, shiny leaves bear little relation to the needles of the conifers, and rhododendron and box do not look well united with juniper and Mugho pine. Still dwarf yew and box can be used harmoniously with Mugho pine and yucca. Since the cultural requirements of the two groups are so different, best results are expected when they are planted wholly separately. The broad-leaved shrubs can be easily combined with deciduous shrubs, the crucial place being where the two extremes join. Semi-evergreen shrubs of broad leaves, as *Lonicera fragrantissima*, make attractive the transition between mountain laurel and spirea. Winter is marked by extreme contrast, assisted by bright berries, or twigs, on the leafless ones.

Partly because of difficulties of cultivation and maintenance,

but equally because an evergreen in northern lands cannot be so casually shoved into a planting as may deutzia and maple, sufficient use is not made of evergreens in plantings for their all-season wear. If more care is employed, not only in attending their physical wants, but in studying further their more effective staging as objects in the landscape picture, gardens will be built more finely. Enthusiasm for the artistic value of conifers, however, must be tempered by a thorough knowledge of their physical limitations.

CHAPTER II

CULTIVATION AND PROPAGATION OF CONIFERS

THE cultivation of conifers presents no special difficulties, if proper soil and exposure are available. The question of hardiness is, of course, all-important. It is not only the problem of temperature the given tree will stand, but also the exposure to winds, and, to a considerable extent, the source from which the tree is derived. Sometimes hemlocks and firs, for example, can be transplanted with safety from adjacent fields or woods, while the same species brought from a more southern or more protected region might not readily establish itself. This is particularly the case with species grown on the northern borders of their hardiness. If the plants are raised from seeds matured in similar or even more rigorous climates, they are usually more hardy.

THE GENERAL CARE AND HANDLING OF EVERGREENS

As to soil conditions, little special research has been undertaken that applies to the cultivation of conifers for ornament. The same is true also as to fertilizers; there is exception to this statement in the growing of young stock in nursery plantations, wherein careful studies are not lacking, but these investigations may not be considered here. In general it may be said that the soil for conifers should be "good," which implies that the same means may be employed for the improvement of land for conifers as for the staple crops. General fertilizing of the land is to be expected to produce good results. In many cases it is desired to plant evergreens on barren outlying parts of the estate; the first consideration is to observe in the neighborhood

or the region what species are most likely to thrive; usually it is not expected to obtain fine specimen trees quickly on such places, if at all; if possible the land should be first improved by good tillage, cover-cropping, and fertilizing.

In the way of actual tillage, little is required for the conifers, although they profit by it when young. The conifers are essentially lawn subjects, and sod is the natural setting. With the present scarcity of labor, however, tall grass and weeds are likely to get the start, making the place to look untidy and to increase hazards of fire. The use of the mowing-machine will greatly help, when scythes and lawn-mowers are out of the question. Once well established, the evergreen plantation should require less care than many or even most other kinds of landscape plantings.

Speaking of experience with conifers in southern Connecticut, George P. Brett writes: "I have tried a mixture of fine bone dust, potash, and nitrate of soda as a fertilizer for evergreens, but not with very satisfactory results, well-rotted cow-manure being the best solid fertilizer for these trees in my experience. But for the tree not yet fully established and for the tree which is ailing, nothing is so good as a liquid manure applied three or four times during the first month or two after transplanting, trees apparently almost dead having come back to life again under this treatment. Last winter, for example, I removed a black spruce of some twenty-five feet in height from the woods, and we thought we had lost it when all its needles fell off in the spring, but under this treatment it grew a new crop of needles and now promises to be as satisfactory as trees of this kind usually are. All manures and fertilizers, unfortunately, greatly increase the growth of weeds and grass at the foot of the trees, choking and eventually destroying the beauty of the lower branches, and the removal of such growth

in a large plantation is a serious matter in these days when labor is so difficult to obtain."

Soils, manures, and mulches for conifers. (John Dunbar.)

The greater number of conifers prefer a well-drained porous gravelly subsoil, overlaid with a light sandy loam. They seem to be particularly happy in a soil underlaid with a porous glacial drift. A few grow spontaneously in swampy grounds, such as tamarack, *Larix laricina;* cypress, *Taxodium distichum;* white-cedar, *Chamæcyparis thyoides;* and common arbor-vitæ, *Thuja occidentalis.* In cultivation, however, they succeed very well in ordinary well-drained soil. In fact, the common arbor-vitæ does well in dryish soils; specimens planted on knolls of light sandy loam underlaid with glacial drift are in excellent health. When conifers are set in clay soil, which is often done, the soil should be thoroughly loosened by trenching or subsoil plowing, and well underdrained. Any available humus, wood-ashes, and well-rotted manure incorporated in the soil greatly aid in rendering it friable and porous for the roots.

All conifers respond well to cultivation in growth and vigor. An area extending from the stem to one to two feet beyond the branches, stirred up with hoe and rake perhaps five or six times throughout the growing season, is very beneficial in conserving the moisture around the roots. Mulching with ordinary well-rotted barnyard manure in late autumn affords much stimulus to growth. By the following spring the manure will be in a desiccated condition and can be incorporated with the soil. William Falconer, who had charge of the Dana Arboretum many years ago, the best cultivator of conifers the writer ever knew, placed a heavy mulch of old straw, rotten hay, or any similar material over the roots of the conifers, and this was maintained throughout the entire growing season. In

PLATE VII. A roadside planting (*Abies cephalonica; A. Nordmanniana; A. concolor*, var. *Lowiana*)

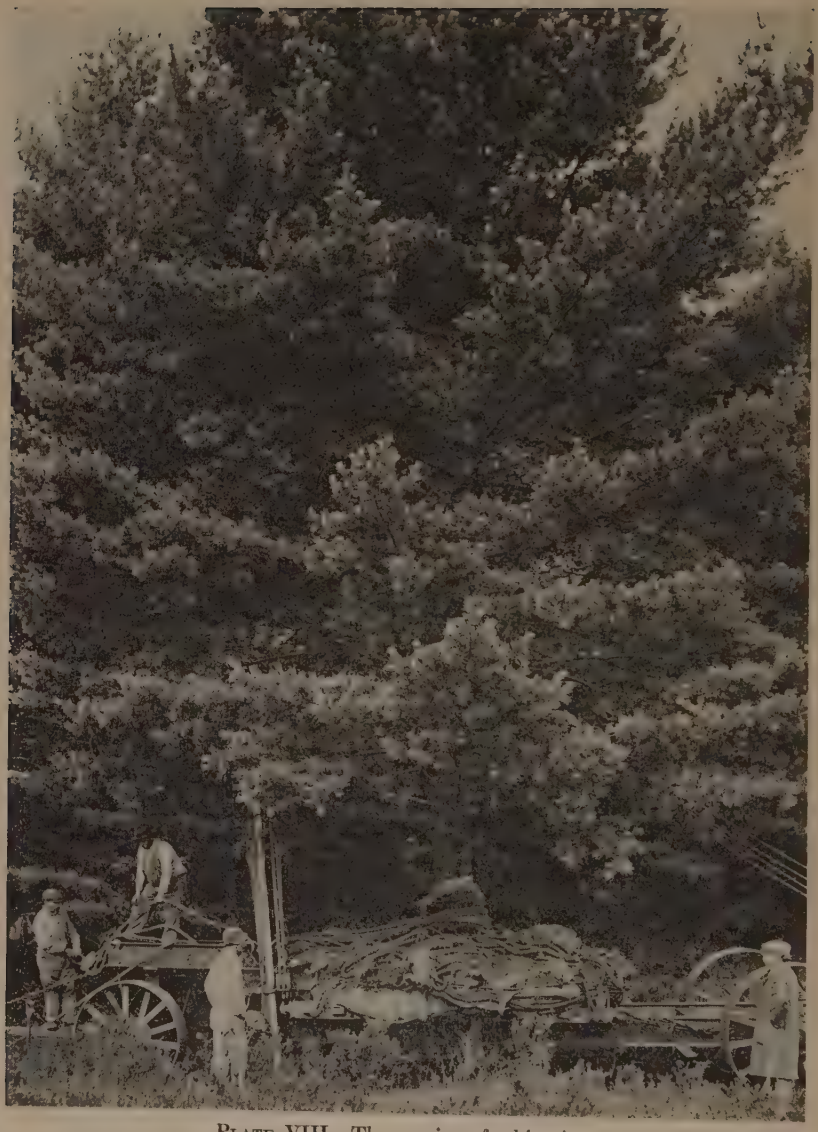


PLATE VIII. The moving of a big pine

their remarkable health and vigor, the conifers certainly showed a quick response to this treatment. Of course, this care mostly applies to conifers in a more or less juvenile condition. When they attain adult size, unless they show signs to the contrary, conifers are usually independent of such cultural attention.

Twenty-seven years ago a street was extended through a hill on the east side of Highland Park, Rochester, New York. There was a cut of about one hundred feet. The slopes were graded to the angle of repose and on the steepest side a retaining wall was built at the base to prevent the sand from sliding. The material on the slopes was sand intermixed with varying glacial drift. About four years later, that is twenty-three years ago, the slopes were covered with Scotch, Austrian, white, and pitch pines, and red-cedar. Rotten hay, straw, decayed leaves, grass mowings, and the like were scattered amongst them. They have grown well and many of them are from twenty-five to thirty feet tall. These slopes now present a very dignified appearance at the entrance to the Pinetum.

At present we are mulching, with stock-yard manure, a number of conifers that show signs of enervation and indicate plainly they need food.

We have recently moved a number of conifers with frozen balls and these are very heavily mulched with manure. In summer they will be soaked with water several times, to enable them to overcome the shock of root disturbance.

In many cases manure is not obtainable. In such event, newly moved conifers should be heavily mulched with rotten straw, rotten hay, or any similar rubbish for a few years until they become established. The frequent stirring of the ground over the roots subsequently will conserve sufficient moisture.

We have never used artificial chemical manures on conifers and cannot say anything about them.

The pruning of coniferous evergreens. (John Dunbar.)

The pruning of conifers is, perhaps, a little more difficult to explain than the pruning of any other woody plants. It seems needless to say that removal of the lower branches is a serious mistake, and, if healthy, they should be retained to the base. Pines, spruces, firs, and hemlocks have conical pyramidal outlines, some more so than others, and the elements of beauty consist in accentuating these attributes. Pruning or disbudding can be intelligently performed to add much to the natural symmetry. The extraction or removal, early in spring, of the central or terminal bud, will tend to compel the branches which start from the side buds to spread apart and form a much denser growth. Cutting back the previous year's terminal growth to a strong bud or branchlet on the main limbs over the tree, if the plant is inclined to be thin in its branching, always produces a much denser lateral growth. In the case of hemlocks, owing to the nature of their terminal growths, the removal of the central terminal bud cannot be accomplished very well, as the bud is very minute. The best method is to cut back the terminal branches to strong branchlets or buds, and a much denser growth will soon follow.

Pyramidal junipers and arbor-vitæ, in which the object is to develop very dense pyramidal habits, are often clipped with shears in spring before growth starts to produce density of growth. In nurseries in which there are thousands of such plants, it may be a matter of business to treat them in this way, in order to facilitate the work. However, on private plantations it is better to use a sharp pruning-knife, or good standard pruning-shears, and cut the branches or projecting shoots back in "shingling" fashion. When carefully pruned in this way, the trees present a more pleasing appearance and do not show such a stiff aspect as when shorn with the shears.

When pruning is skilfully performed, the ordinary observer cannot detect what the pruner has done. Pruning or disbudding of conifers requires very intelligent observation, and one should have the desired results definitely in mind. Of course, there are different opinions about the pruning of conifers, some growers preferring to leave them entirely alone. However, a little pruning and disbudding in the juvenile state develops natural beauty. This applies to conifers from an ornamental standpoint, but from an economic or forestry point of view this pruning has no application whatever.

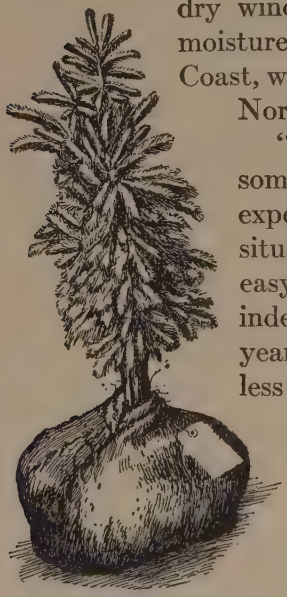
The transplanting of conifers. (Figs. 2, 3.)

There is wide difference of practice in the time of year for the transplanting of coniferous evergreens, which means that no one season is imperative. John Dunbar writes that he transplants "conifers at all times of the year, excepting midsummer when they are in full growth. The best success is secured in spring when the buds begin to swell. From the end of August to the middle of September, if there have been abundant rains and the ground has been well soaked, is a very good time to move conifers. They may be planted late in autumn when circumstances compel it, but there is likely to be a considerable percentage of loss. Valuable conifers that stand in proximity to each other and require removal for better development, can be transplanted in winter successfully with large frozen balls on stone boats or tree-moving machines

2. A good ball of earth for transplanting.

adapted to the purpose. The roots of conifers are very susceptible to injury from exposure to the air, and the utmost vigilance should be exercised to keep them covered and moist.

"The climate of eastern North America is not adapted to the successful growth of many beautiful conifers, and very few of the species toward the Pacific Coast succeed in the East. This is due not so much to the cold as to the fierce, sweeping dry winds of late winters. The precipitation of moisture is much more abundant on the Pacific Coast, west of the Cascade Range, than it is in the Northeastern States."



3. Prepared for shipment.

"With the exception of the hemlocks and some of the firs," writes George P. Brett from experience in southern Connecticut in exposed situation, "all the evergreens have proved easy to transplant with us. Some of them, indeed, can be moved at any season of the year, but we have usually found our losses less when the trees have been transplanted in the early spring months, this spring planting being superior to fall planting in this section of the country on account of the increasing winds of winter adversely affecting the fall-planted tree. Great care, however, must be taken to keep the roots constantly wet. They must never be allowed to get at all dry, and when transplanting from the wild, if a ball of earth cannot be obtained, some means must be adopted for keeping the roots wet until they are again planted. The wind is also a great enemy of the transplanted tree, especially of the evergreen, its mass of foliage catching the winds as would a sail, with the result that newly planted trees, unless

firmly guyed, generally work a hole around the stem of the tree which will, if unfilled, eventually dry the roots. Most of the losses in my early plantings were due to this cause."

The moving of large evergreens. (Plates VIII, IX.)

The removal of large conifers, above the usual nursery or transplanting sizes, is a special practice, and the success of it depends on large experience and often the use of special hoists and trucks. The following explanation is from the experience of Henry Hicks, as told in the Standard Cyclopedia of Horticulture.

"Large evergreens are moved with a ball of earth because they have no dormant period, but carry their foliage and need moisture at all times of the year. It is essential that the ball of earth contains a sufficient amount of small fibrous feeding roots to support the tree and that the tree be kept well watered for two or more seasons until the tree has spread its roots over sufficient area to gather enough rainfall to sustain the normal growth. The extent of fibers in the ball is increased by transplanting and root-pruning. Root-pruning is less essential with trees having an abundance of fibrous roots than with trees having only a few large coarse roots in the central portion. Some trees, as white pine, will survive with a comparatively small number of roots, their drought-resistant qualities enabling them to persist with a small supply of moisture. Other evergreens, as Nordmann's fir, have a long carrot-like tap-root, and the tree is likely to die if this is cut and the tree given an inadequate quantity of water. Frequent nursery transplanting is, therefore, necessary with this species.

"Trees are dug by starting a trench at a radius from the tree about three feet wider than the ball of earth to be taken. The roots are cut off on the outside of the trench and the soil dis-

sected out from between the roots back to the size of the ball. These roots are bent around against the ball of earth if they are flexible enough to bend. If not sufficiently flexible and tractable, they are cut off.

"A canvas is made fifteen to twenty-four inches deep, and is made smaller at the bottom by folding over a V and sewing it. This makes it fit a conical ball and, when it is pulled up three inches by the cross-lashing at the top, makes it tighter. The canvas has cross-ropes sewed on it with rings at the top and bottom, and on the deeper balls two rows of rings in the middle. The bottom rope is tightened by a wooden lever twenty inches long with four holes, the rope being looped through the holes and the lever thrown over to pull the rope tight. The top rope is then tied and tightened by cross-lashing.

"To get the ball free from the subsoil, dig under all around and tip the tree slightly. Level off the bottom with a fork. If there are tap-roots, tunnel under and cut them with a saw. Put a platform as far under as possible and tip the tree back. To get the ball in the center of the platform, put a hammock around the ball and pull. Hold the platform in position by crowbars driven in front of it. Lash the ball to the platform, make an incline, drag the platform out of the hole onto a truck or sled. Skids with small wheels set in them about one foot apart enable a team to load a ball quickly. With balls ten to fifteen feet in diameter and twenty inches deep, jacks and pipe rollers are needed.

"Trees over ten feet need to be tipped over to go under wires. If the canvas is put on tight and at the proper taper, and if the ball is cut flat to fit close to the platform and lashed tight to the platform, the tipping can be done without the ball shaking loose. Sometimes a canvas or burlap bottom can be put between the platform and the ball. In unloading, the tree

is stood up, team hooked to the platform and the tree dragged off to the ground. The tree may drop two feet without injury. The platforms are dragged to the hole and balls less than four feet rolled into the hole. Larger balls have the platform dragged into the hole and the platform pulled out, holding the tree in position by a hammock. To straighten the tree, tramp the earth solid under it until it stands erect. Take off the canvas, spread out the side roots, pack the earth and anchor as with deciduous trees. Keep the ball moist; examine it once a month or more often by digging or boring into the ball during the first two years. Evergreens moved with a too small ball or with not enough fibers in the ball or with the watering neglected, may grow three inches a year for the first two or three years. If properly moved, they will grow six inches or more a year—half their normal growth.

"Deciduous trees may be moved with balls of earth by the above method, and it has proved an aid with difficult species, as beech, oak, liquidambar, tulip. Especially when previously transplanted or root-pruned, the above trees three and one-half inches in diameter moved with a ball of earth four feet in diameter are very successful, while without a ball many are lost or the growth is much slower. Investigation should be made to see whether this is because of less disturbance of the roots or because there is carried with the roots and soil a mycelium of a fungus which aids the roots to take up plant-food and moisture.

"The time of year for moving trees is of minor importance. It is overemphasized by purchaser, landscape architects, and nurserymen, and results in heavy financial loss to nurserymen in congesting sales and their own planting in the short spring season. It greatly lessens the total amount of planting needed for forest, shelter-belt, landscape, fruit, and other economic

purposes. A nurseryman may plant all the year. Evergreens can be taken up with a ball of earth even in May and June. The new growth may curve down. After June 20, the spruces, and after July 10, the pines, are firm enough not to wilt. August-September sales with a ball of earth are just as successful as April. The ground is warm and the roots grow rapidly; the ground can be made moist. Weather in September is less dry than in May and June.

"Small evergreens up to two feet high may be planted in August and September from one part of the nursery to another without balls of earth, if the roots are very carefully dissected out without breaking. There will be more failures if the week following planting is hot and dry.

"Planting with balls of earth may continue all winter, especially if the ground is mulched to keep out the frost and permit economical digging of the tree and the hole. The frozen ball of earth is an old method, frequently referred to, but is not an aid. If the ball is frozen solid and remains so for one or two months with dry winds, the top may dry out and die as has occurred with red-cedar. If the ball is not frozen, sap can come up to take the place of that lost by transpiration.

"A ball of earth three feet in diameter is needed for an evergreen eight to ten feet high; four and one-half feet in diameter for an evergreen fifteen feet high, except red-cedar which can have a ball three feet; a ball of earth twelve feet in diameter is needed for a pine thirty-five feet high. Root-pruning pines, spruce and hemlock permits moving the following year with a smaller ball than otherwise. In root-pruning, the trench can go three-quarters of the way around or three or four of the larger roots can be left across the trench to keep the tree from blowing over. Root-pruning of red-cedars is of less advantage and is rarely practised. In New England and northern New

PLATE IX. Details in the moving of a big pine

PLATE X. Dwarf Japanese yew (*Taxus cuspidata* var. *nana*)

York, the pine, spruce and hemlock have only a few coarse roots just under the surface and no roots extending two feet deep. When moved to better-drained soils on the coastal plain, they develop deeper roots and have ten times as many fibers in a ball four feet in diameter. The above evergreens with their shallow root-systems can be taken up with a disc of roots, peat and grass eight inches deep and three to four feet wide. This can be set on a wagon and trees ten to fifteen feet high easily moved. Less roots will be broken or bare if the ball is tied in burlap. The usual cause of failure in this operation is neglect of watering. Hemlocks and probably other trees will be aided by shading for the first two months."

PROPAGATION OF CONIFEROUS EVERGREENS.—Ahrens

The conifers are multiplied by three general means, each of which may be discussed briefly: by seeds, by cuttings, by grafts. This account considers good nursery practice in the growing of plants for ornamental planting, and particularly of choice named stock. The growing of forest trees is quite another undertaking, on which there is a useful literature; the discussion of that subject is not undertaken in this book.

Propagation by seed.

The time of gathering the seed of evergreens is very important, when the cones begin to open near the tips being the proper time. The seed should be gathered at once, otherwise it will be lost. It should be kept in a cool place until sowing. Seed to be sown out-of-doors should be stored during winter in a cool dry room where the temperature does not fall below 36 degrees Fahrenheit. It is advisable to leave the seed in the cones until the weather permits their sowing. They should be sown in beds or frames, the small seed broadcast and large

seed, like pinus, larix, and taxodium, in rows. The best soil is sandy loam. The seed must be protected from the birds with cheese-cloth. When the seedlings have developed the first two leaves the cloth may be removed at night and replaced during the day, and after they show the typical growth the cloth may be removed entirely. Careful watering is very necessary. This should be done in the morning with a fine rose, back and forth, to prevent the earth from forming a crust due to flooding.

During the first winter, seedlings should be protected with a few dry leaves thrown over them and covered with evergreen boughs. The second winter, hardy evergreens do not need covering, with the exception of *Tsuga canadensis* and some tender abies.

When the seedlings are three years old it is time to transplant; however, larix and taxodium transplant better when two years old. Transplanting should be performed before the seedlings start the new growth, dipping the roots in a bath of good stiff clay dissolved in water, to prevent drying. To cause the formation of a good root system, these seedlings should be transplanted every two years until they are ready to be set permanently. Evergreens transplanted often will keep a good shape and ball and may be moved any time in spring or fall, when those not transplanted will be a total failure.

Older plants which become bare around the base may be given new life by digging around the tree two feet deep, keeping out far enough to prevent the cutting of any roots and filling the hole with good fertile soil.

Tender evergreens should be sown in flats or pans in the greenhouse. A drainage of broken pots of about three-fourths of an inch should be placed at the bottom, and the flat then filled with a mixture of good leaf-mold and potting soil, with enough sand to make it mellow. After the seed is sown, it

should be covered according to size, the small seed liberally, and large seed with more covering. The flats are kept in a greenhouse or frame with temperature about 50 to 60 degrees Fahrenheit. One should always water in the morning. Careless watering often spoils all the seedlings during the summer. The seed-flats should be protected from the hot sun. When winter comes the flats may be placed in a cool frame against a greenhouse, preferably being supplied with a line of hot-water pipes to keep out the frost; if this cannot be provided, a good cellar will answer. In moderate weather, plenty of fresh air should be furnished. The plants must not be kept too wet, but care should be taken that they do not dry out entirely. The second year, about the middle of September, the strong plants may be placed in pots, and planted out in spring; the smaller ones may be transplanted in flats and kept for another year, potting in September to be set out in spring. After two years the transplanting should be repeated.

Further advice on the propagation of conifers, particularly pines, by means of seeds is given as follows by E. Bollinger: "The method of propagating pines on a large scale is by seeds. The seeds are sown from the end of March to May 15, depending on weather and climatic conditions. The ground should be prepared in the fall if possible.

"The preparation of the soil should be most thorough. It should not only be plowed deep, but cross-plowed and pulverized until it is in fine tilth and free from all lumps and stones. If the land is poor, a liberal application of well-decomposed barnyard manure should be plowed in, and in the fall a lighter application may be given if the ground is prepared in spring. The best soil for pine seed-beds is a loam.

"When the land is properly prepared, the beds are staked off uniformly not more than four feet wide, slightly elevated

in the center. This width facilitates sowing, covering, and weeding operations. A very light wooden roller or the back of a spade can be used to smooth down the seed-bed. Thus the seeds can be seen easily, and a more even sowing accomplished. Sowing should be done on a calm day, covering the seed with a sandy loam to a depth of about four times the thickness of the seeds, and again passing the roller over the beds or patting with back of a spade. The beds should be shaded either with lath frames or overhead brush shades, both proving satisfactory. The overhead brush shade, seven to nine feet high, is perhaps nearer to nature and requires less care. At no time should the seed-beds be allowed to dry out until the young plants are sufficiently developed and strong enough to stand draught, which is about seven to ten weeks after sowing. Lath frames should be watched closely in damp or hot weather and sufficient air supplied, otherwise the tender seedlings will suffer from dampening, especially if they have been sown quite thick. Sharp clean sand spread evenly to the thickness of about one-twelfth of an inch will usually remedy damping off.

"Seed-beds should be kept clean from weeds, especially during hot and dry weather. Such weeds rooting deeply should be removed carefully, or cut with a sharp knife. The slightest heaving of soil gives a chance for the drying out of the tender seedlings. The seed-beds should be covered in the early winter with clean marsh hay to the depth of about one inch, to prevent thawing and freezing. This should not be done until the ground is frozen to about three to four inches. The plant should be allowed to remain in the seed-bed for two full years. Some gardeners transplant the second year in beds prepared the same as the seed-beds, where they can easily be taken care of, watered, and shaded. They should remain in these beds for one or two years, and then planted in a permanent position."

Propagation from cuttings.

The middle of September is about the time to begin propagating by cuttings. The flats should be eighteen inches long, fourteen inches wide, and five inches deep. Three-fourths of an inch of broken pots should be placed on the bottom, then three-fourths inch of potting soil, and the remainder of the flat filled with sand, which must be tramped in with the feet to make it very solid. Loosely packed flats are not satisfactory. The sand for propagating should always be covered, to preserve the natural moisture and to avoid the necessity of much watering. Good lake sand, not too fine, is the best; when this cannot be obtained, other good sand can be used, but it must be clean and not mixed with clay or other binding material.

Good vigorous cuttings should be taken from one-year growth with a two-year heel, and trimmed for one and one-fourth inches. They should be set in the rows two inches apart, using a dibble with a blunt point, placing with the cut directly on the sand. They should then be pressed and firmed, for cuttings put in loosely will not root well. After a moderate watering, the flats should be put in an air-tight shaded frame.

When the cuttings are beginning to heel, the flats may be placed on the sand in the propagating bench. Starting with a moderate bottom heat of about 65 degrees, after a month the temperature may be raised to 70 degrees, care being taken not to dry the flats from the bottom. To prevent this, a funnel is put between the flats and sufficient water poured through to keep the sand on the bench moist.

At the end of May well-rooted cuttings may be planted from the flats in the free ground. The cuttings should be carefully shaken out and the roots dipped in dissolved clay to prevent the young roots from becoming dry. The rows should be about eight inches apart, and the plants set at the same depth as

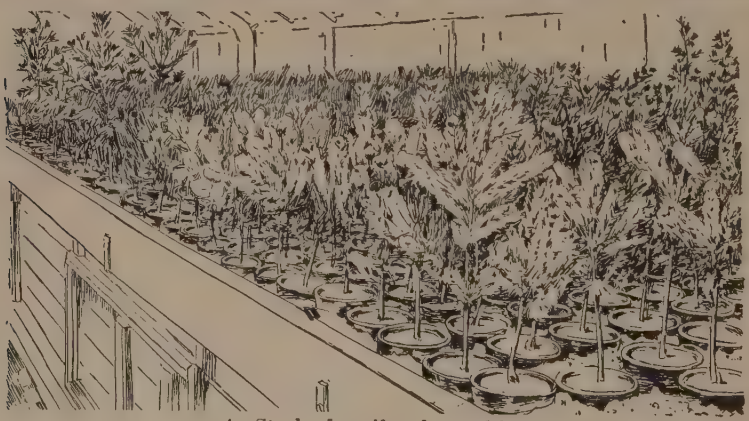
they stood before, packing the soil firmly. During the summer the soil should be loosened frequently with the garden hoe.

Some of the more slowly rooting evergreens, such as retinispora or chamæcyparis, some junipers, *Thuja orientalis*, *Cedrus libani*, and all picea, should be left in the flats in a half shady place during summer and potted in September. Taxus cuttings, even if well rooted, should not be planted out in spring, but should be potted in September and kept over winter in a frost-free frame or a cool greenhouse.

Propagation by grafting. (Figs. 4-7.)

Varieties which cannot be grown from cuttings or seed must be grafted. If possible, the stock for grafting should be potted one year before use. When potted in fall it should be well rooted before grafting. Different sizes must be selected as it is difficult to put a small graft on a thick stock.

Grafting should be performed on stock in the same class; juniperus should be grafted on *J. virginiana*, thuja on *T. occidentalis*, picea on *P. Abies*, abies on *A. concolor*, for although this is a more expensive stock it is far better than *A. balsamea*.



4. Stock of conifers for grafting.

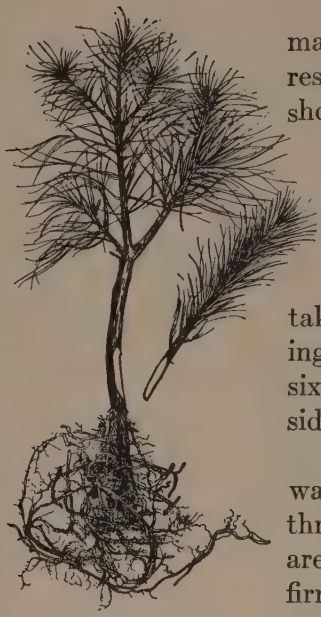
For *Pinus Jeffreyi*, *P. attenuata*, *P. ponderosa* var. *pendula*, and all other forms *P. ponderosa* stock should be used. All pines resembling *P. nigra* var. *austriaca* should be grafted on that stock. *Pinus Strobus* varieties should be grafted on that species, as well as *P. cembroides* vars. *monophylla* and *edulis*, *P. Bungeana*, *P. flexilis*, and *P. aristata*. For *P. Mugo* and its var. *Mughus*, *P. rigida*, and varieties of *P. sylvestris*, the latter should be

5. One-year grafts.—From left to right: Abies numidica, Pinus cembroides var. edulis, Picea Breweriana.

employed. *Pinus resinosa* must be used for its varieties as they will not grow on any other stock. Varieties of tsuga should be grafted on *T. canadensis*, and forms of pseudotsuga on *P. taxifolia*.

Plenty of sand should be used in the propagating bench. To prevent the heat from scorching the roots, the pots should be plunged in the sand and given moderate bottom heat. Plants potted a year before should not be plunged as they will start to grow without this treatment.

The time for grafting is when the plants show young roots. The graft should be placed as near the root as possible,



6. Stock and cion of white pine.

making the bark of graft and stock correspond and then tying firmly. The graft should be cut near the tip of the tree when there is no frost. In four to six weeks the grafts begin to grow out. If the bandage is cutting the bark, the strings may be loosened at the bottom near the root, but the bandage must not be taken off entirely. When the graft is growing well, the stock should be cut back about six inches above the graft, leaving enough side shoots to keep the stock growing.

Before grafting, the stock should be watered thoroughly. In about two or three days, if the grafts are set well and tied firmly, no water will soak into the cuts, and after this they may be given water when it is needed.

For about eight weeks the house should be kept closed, after which time a little air will not harm the grafts.

At the end of May the grafts may be planted out. The side shoots on pinus, picea, and abies should be left on the stock. This is needed to root the plants and may be removed the following spring. Juniperus and thuja can be cut off near the graft in July. They will grow all summer. The plants should remain about three years and afterwards be transplanted every two years.

7. The union completed.

PLATE XI. Spreading English yew (*Taxus baccata* var. *repandens*)

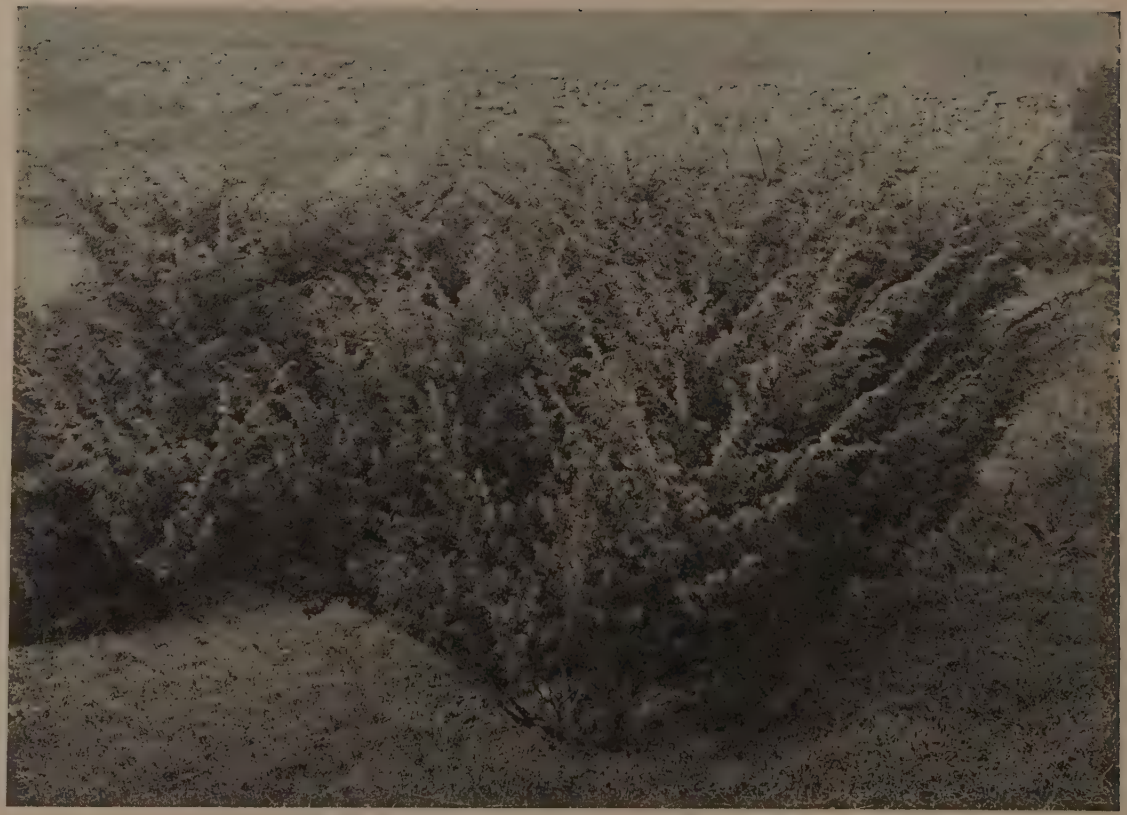


PLATE XII. Common juniper (*Juniperus communis*)

CHAPTER III

ADAPTATION OF CONIFERS

THE keynote to success with conifers is adaptation; and of course the adaptation is really a local problem, differing with each separate place. A few wide-spread and prevalent species, as white pine, Austrian pine, Norway spruce, arbor-vitæ, can be made to thrive under diverse conditions, but, for the most part, each species is peculiar unto itself and the intending grower must read all the notes he can find on the adaptation to his region, closely observe successes and failures where the plant has been tried; and often he must set more plants than he needs, with the expectation that some of them will succeed. The present chapter is mostly a record of experience in adaptation in different regions.

CONIFERS IN THE NORTHEASTERN STATES.—Dunbar

Conifers have formed a very important part in decorative gardening for hundreds of years. Their variable forms are well adapted to many expressions of landscape gardening in parks, cemeteries, private estates, and small gardens. Some of the hardier forms are admirable for screens, protective belts, and windbreaks.

In ornamental gardening, the growing of many conifers, with sufficient room for spread of branches and adult development, so as to give ample opportunity for individual expression, has appealed to many devotees of gardening with keen artistic perceptions, and numerous collections have been established on private estates in Europe and the United States. A notable collection of conifers was established at Dosoris, Long Island,

New York by the late Charles A. Dana about fifty years ago, and was maintained for many years in excellent cultural condition. Mr. Dana loved them most intensely. Perhaps the most notable private pinetum in this country at the present time is on the Hunnewell Estate, Wellesley, Massachusetts, which had its beginning between sixty and seventy years ago, by the late H. H. Hunnewell, and is still well maintained. Many of the conifers have attained large adult size and are in excellent health.

The largest public collection of conifers in this country is the pinetum at the Arnold Arboretum, Jamaica Plain, Massachusetts, where all of the known hardy species of the northern hemisphere, and all of the available horticultural forms are assembled. It affords an excellent opportunity for the gardener, horticulturist, and landscape-gardener to study the particular forms they have in mind for special purposes. The next largest public collection of conifers is in the Arboretum of Highland Park, Rochester, New York. The planting of the nucleus of this collection was in the spring of 1896, and many of the conifers put out at that time have reached a height of thirty-five to forty-four feet.

Pines.

It is fortunate that the white pine, *Pinus Strobus*, one of the most beautiful of all conifers native as far north as Newfoundland, is so well adapted to cultural conditions. In very exposed situations the white pine may become partly browned from the sweep of cold penetrating winds. Nevertheless, it makes a noble windbreak when planted rather closely as the trees give mutual support to each other. The plants may be set seven to eight feet apart and when they begin to crowd they should be thinned out and planted elsewhere. The white

pine is a beautiful object standing alone on the edge of a lawn. It is highly ornamental under varying conditions and with its horizontal branches, slightly curving upwards, succeeds well in light sandy soils.

The pyramidal white pine, *Pinus Strobus* var. *fastigiata*, is a noble plant in formal gardening. It does not appear to have been in cultivation many years and specimens are not known over twenty-five feet tall. The dwarf white pine, *P. Strobus* var. *nana*, forms a low round bush which in ten years does not exceed three feet in height. This is a most important variety in a situation in which a low conifer is required.

The Swiss stone pine, *Pinus Cembra*, from central Europe, is of remarkable beauty and quite hardy, as the foliage is not browned by the coldest winters. In its juvenile state it forms a dense pyramid and is of very slow growth. This pine is well adapted to situations in which space is much restricted. It requires moist good soil.

The limber pine, *Pinus flexilis*, from the mountains of California and New Mexico, has usually horizontal and pendulous branches, forming a very beautiful outline. Its leaves are short and rigid and look quite different from other white pines. It is quite hardy, of slow growth, and seems to thrive best at the base of a slope where moisture is abundant, but well drained.

The Korean white pine, *Pinus koraiensis*, is not a common conifer in American parks or gardens, although it was introduced many years ago. The branches spread horizontally, but are somewhat divergent and are inclined in some individuals to be rather thin. It is very hardy and of slow growth, and is well adapted to restricted situations. Occasional removal of the central buds in spring to produce a dense lateral growth is beneficial.

The Japanese white pine, *Pinus parviflora*, has a very characteristic aspect. The short leaves give a tufted, crowded

appearance. The branches are usually horizontal and occasionally somewhat divergent, and the habit picturesque. There are fine specimens of this species in the Arnold Arboretum. It is not particular about soil conditions. A very decorative form or variety with silvery-bluish leaves appears amongst seedlings occasionally.

The tree sometimes called the Macedonian white pine, *Pinus Peuce*, from the mountains of southeastern Europe, bears a general resemblance to the Swiss stone pine in its pyramidal habit. It is slow growing and quite hardy and well adapted to small ornamental grounds. It appears more subject to the attacks of the pine-leaf scale than any other white pine.

The Bhotan white pine, *Pinus excelsa*, from the Himalayas, is characterized by handsome long leaves frequently eight inches in length. The branches are horizontal, drooping, and occasionally divergent. A well-developed individual on the border of a lawn is an object of much beauty. A fine specimen, fifty feet in height, is now standing on the grounds of the Genesee Valley Club, East Avenue, Rochester, New York. A number of individuals have been lost from the stems being punctured by sapsuckers, and they appear to "bleed to death." There is no remedy for this, except, perhaps, to destroy these birds and this is not permitted by law.

The Mexican white pine, *Pinus Ayacahuite*, native in Mexico, has long leaves and bears some resemblance to the Bhotan white pine. The horizontal slender branches are sometimes inclined to droop, which gives the tree a most graceful appearance. This pine has a reputation for being tender, but it passed through the very cold winter of 1917 and 1918 a little browned but recovered thoroughly. It should be planted in a situation well protected from the sweep of the prevailing cold winds and in moist, well-drained soil.

The mountain or western white pine, *Pinus monticola*, native from British Columbia to northern California and Montana, bears a strong resemblance to the eastern white pine. The leaves are a little stiffer and shorter than in the latter. It grows very slowly in the East, and the largest specimen is perhaps twenty-five feet tall. It never shows the slightest signs of injury from cold. The habit is broadly pyramidal, and it appears to be a good plant for small gardens.

The single-leaf, or pinon pine, *Pinus cembroides* var. *monophylla*, is a native of dry regions from Utah, Nevada, and Arizona. It forms a dense broad pyramid about ten feet tall. It always attracts attention from connoisseurs on conifers because of its distinctive characters. The foliage is bluish-green.

Amongst the three-leaved pines the most useful species is the bull pine, *Pinus ponderosa*, native from British Columbia to western Texas. There are individuals of this handsome pine in Rochester, New York, fifty to sixty years old and sixty to seventy feet tall, in perfect health. It passes through the severest winters without injury. The branches are spreading and variously curving. The long handsome leaves are thickly disposed on the branches, and the whole aspect when well developed is very dignified. The bull pine seems most at home in a well-drained moist soil at the base of a slope or in a ravine. The variety *pendula* has very long drooping leaves, with the branches slightly pendulous, and is very distinctive. There is an excellent example of this pendulous variety on the grounds of the late W. C. Barry, forty feet tall. A variety known as *scopulorum* from the Rocky Mountains is smaller than the type. Plants in the Pinetum are now five to six feet tall and look very promising.

Jeffrey pine, *Pinus Jeffreyi*, from southern Oregon to California, is much rarer in cultivation than the bull pine.

It forms a narrow pyramidal outline. The leaves are dense and bluish-green, and it is quite hardy. It has attained a height of thirty-four feet in the Pinetum in twenty-six years.

The lace-bark pine, *Pinus Bungeana*, from China, has slender curving branches and forms a dense tree. When it passes the juvenile state, the bark of the main bole begins to assume a peculiar, flaky, light gray aspect. It grows slowly and has a bushy appearance for a number of years. It is quite hardy. The bark on the stems of adult trees in China is said to be white.

The pitch pine, *Pinus rigida*, native throughout the Northeastern States, is likely to be despised by some planters, but it adds a picturesque appearance in adult age to the landscape. It will grow and look happy in pure sand. It is, therefore, to be recommended for sandy areas and slopes.

The knob-cone pine, *Pinus attenuata*, has done surprisingly well in the Pinetum. It is mostly native west of the Cascade Range. It is now twelve feet tall, and has been growing for eighteen years. It has been badly browned in severe winters, but has always recovered.

Coulter pine, *Pinus Coulteri*, and Sabine pine, *P. Sabiniana*, beautiful three-leaved species from the West, did very well in the Pinetum for about seven years, but were killed outright by a severe winter.

Amongst the two-leaved species, the red or Norway pine, *Pinus resinosa*, native throughout the Northeastern States to Newfoundland, is perhaps the most useful for ornamental planting. It is very hardy and adapts itself to many situations and soils. It appears to do remarkably well in clay soil. When isolated it forms a broad round head towards adult age. The foliage is abundant and massive. For the landscape-gardener this is a most important pine for bold effects.

The Swiss mountain pine, *Pinus Mugo*, from the mountains of central Europe, has an ascending shrub-like habit, from a wide base, and grows to twenty feet or more in height. It is very hardy and does not brown in the coldest winter. It is very important for small gardens.

The mugho pine, *Pinus Mugo* var. *Mughus*, is exceedingly variable. Occasionally it forms a low mat on the ground not over three feet high and twenty feet across and again it will grow to a height of fifteen feet and form a broad rounded mound. A low variety is sold under the name of *compacta*, and is a most desirable plant for many situations. The mugho pine in its many forms is one of the most important low pines for parks and gardens, as it is well suited to different soils and exposures. It is not injured in the bleakest exposures.

The Scotch pine, *Pinus sylvestris*, has been planted extensively in this country and various opinions are expressed about its utility. It maintains a good appearance from fifty to seventy years in most cases, other conditions being equal. It grows rapidly and is absolutely hardy. The branches are usually spreading and sometimes pendulous, and when well grown it is ornamental. Adult trees are characterized by yellowish-brown bark which is quite ornamental in a winter landscape. As a protective tree in a windbreak, the Scotch pine is one of the best and does well in poor soil. There is a form, var. *argentea*, with silvery-blue leaves, which is very distinctive. There are two dwarf varieties, *pumila* and *Watereri*, which are excellent for small places and useful in rock-gardening. An upright columnar form, var. *fastigiata*, is now in the trade.

The typical form of the Austrian pine, *Pinus nigra*, native through Europe to western Asia, is proving very satisfactory. Plants raised from seeds collected by the late Henry J. Elwes, in Bosnia, are now twenty-five feet tall. The stout branches

form a very symmetrical pyramidal head with the upper branches ascending. The leaves are very dark green. This species is rare in cultivation in this country. The var. *austriaca* is planted as extensively as the Scotch pine. With its stout spreading branches and large dark green leaves, a well-developed Austrian pine is an object of much beauty. It is perfectly hardy in the coldest exposures, and makes an excellent windbreak as it grows rapidly. It seems to maintain itself well in this country for at least sixty to seventy years. The Crimean pine, *P. nigra* var. *Pallasiana*, with stout branches, thin branching habit, and dark green prominent leaves, is now thirty feet tall at Highland Park. The Pyrenean pine, *P. nigra* var. *cebennensis*, is a low-growing form with a broad base and orange-colored branchlets.

The Japanese red pine, *Pinus densiflora*, in fifteen years forms a handsome round-topped tree. During the severe winter of 1917 and 1918 it suffered considerable injury, but quickly recovered. The var. *umbraculifera* is perhaps better known in gardens than the type, and forms a low, round bushy top. It is a most excellent plant in formal gardening.

Thunberg pine, *Pinus Thunbergii*, from Japan, has a very thin branching habit, with heavy branches somewhat sprawling. It is not handsome but has a picturesque appearance and is quite hardy. In twenty years it forms a tree twenty-three feet tall.

The jack pine, *Pinus Banksiana*, has no ornamental value, but to some persons it has a picturesque appearance. It is very hardy, as it grows as far north as Hudson Bay. It does well on sandy slopes. The slender branches are spreading and occasionally much divergent.

The table mountain pine, *Pinus pungens*, native from New Jersey to North Carolina, has a decidedly flat-topped pictur-

PLATE XIII. Pfitzer juniper (*Juniperus chinensis* var. *Pfitzeriana*)

PLATE XIV. A margined walk.—(*Juniperus chinensis* var. *Sargentii*)

esque appearance, quite distinct from any other pine. After ten to fifteen years specimens mostly assume a yellow, sickly appearance. This pine appears to be quite hardy. The cones are very persistent, clinging tenaciously to the branches for ten or fifteen years, perhaps longer, and are difficult to remove.

Larches.

The Chinese golden-larch, *Pseudolarix amabilis*, is an elegant ornamental tree. The branches are long and spreading and very irregularly whorled, with the lower ones horizontal and the upper ascending. The branchlets are yellowish-brown. The leaves are deciduous, light pale green, two to three inches long, in dense spire-like clusters. The foliage turns to a clear deep yellow in the autumn. It requires a light, sandy, moist, loamy soil to be in good condition. It is quite hardy, and the oldest trees in this country show no signs of failing. The largest trees at Highland Park are twenty-six feet tall, eighteen years planted.

The larches are deciduous conifers, but all are beautiful ornamental trees. The European larch, *Larix decidua*, commonly distributed throughout central and northern Europe, is a valuable tree for parks and private estates. The habit is pyramidal and often forms a long spire-like top in adult trees. The branches have a yellowish-straw color. The fine deep green leaves, which when unfolding in spring have a yellowish-coppery tinge and in autumn assume a yellowish-bronze color, are very attractive. The European larch does very well in light sandy soil and grows rapidly.

A hybrid between *Larix decidua* and *L. Kaempferi* (*L. eurolepis*) which appeared in Scotland, is growing rapidly in the Pinetum. The young trees are still small but they are making good progress.

The Japanese larch, *Larix Kaempferi* (*L. leptolepis*), has very broad horizontal branches, which curve upward and form a very broad pyramid. The leaves have a bluish-gray tinge. The branchlets are characterized by a reddish-brown color. In the autumn the leaves turn deep yellow. Japanese larch does excellently in cultivation, and is a most desirable ornamental.

The American larch or tamarack, *Larix laricina*, native from Manitoba to Pennsylvania, is usually found in swamps and very damp soil. It forms a narrow pyramidal head when young, but in old age it is often very irregular in outline, and the branches, particularly in adult trees, are arranged very irregularly. The tamarack, when isolated and well developed, is a very ornamental tree. Although usually native in wet soils, it does very well in ordinary well-drained ground.

The Dahurian larch, *Larix dahurica*, from east Siberia, has very wide-spreading branches, much more so than in any other larch. The branchlets have a slightly glaucous tinge. The leaves are a deep olive-green color. It is slow growing, but is highly ornamental. Var. *Principis Rupprechtii* is doing very well at Highland Park. The seedlings are young, but they give good promise of becoming well established.

Cedrus.

The cedar of Lebanon, *Cedrus libani*, native on the Lebanon Mountains and in northern Africa, is one of the noblest conifers. The geographical form that has been commonly cultivated in Europe and in some parts of this country is not hardy in western New York or in any part of New England. Many years ago C. S. Sargent had seeds collected on the highest mountains in Asia Minor, where the species occurs. This race, fortunately, has proved to be quite hardy at the Arnold Arboretum, and the young trees are now of considerable

size. It is very satisfactory at Rochester. The stout horizontal branches, radiating very irregularly and forming a broad head, present a picturesque appearance. It requires a warm, rich, well-drained soil.

The Atlas cedar, *Cedrus atlantica*, and the var. *glauca* failed in western New York in severe winters. In Long Island and New Jersey, however, they succeed remarkably well, and healthy specimens can be seen on various estates.

Hemlocks.

The hemlock, *Tsuga canadensis*, is native from New Brunswick and Wisconsin south to northern Georgia. Although the species grows far north, when it is planted in situations exposed to the sweep of cold dry winds, it is likely to be badly browned on the sides exposed to the winds. The plant is usually gregarious in a wild state in gulches, valleys, and river-gorges where moisture is abundant and naturally well drained, and depends on mutual support by growing in masses. The hemlock is one of the most graceful conifers, and it is indeed fortunate that such a lovely conifer can be cultivated in the parks and gardens of the northeastern United States. The slender branchlets droop gracefully, and in a well-developed individual the lights and shadows are displayed with fine effect. The late Josiah Hoopes, a great admirer of conifers, declared that if he were restricted to one evergreen, he would surely select the hemlock. In a well-protected situation on the lawn, the tree retains the lower branches for many years. It is a mistake to plant the hemlock in a dry, poor soil. The tree makes a very beautiful protective screen or belt, other cultural conditions being equal. When skilfully managed it produces a most beautiful hedge and stands the shears well. The var. *pendula* is one of the most graceful pendulous conifers, and

forms a flat, broad, low top, with branchlets drooping at the ends of the branches. Fortunately, this handsome plant is sold in many American nurseries. Var. *globosa* is a low bushy form, well adapted to restricted situations in the garden. Var. *atrovirens* is dense and compact, forming a low, broad pyramid. It appears to attain a height of twenty feet and perhaps much higher.

The Carolina hemlock, *Tsuga caroliniana*, native from the Blue Ridge Mountains to northern Georgia, is very distinct in its character from the common hemlock. It is a smaller-growing tree and has a more compact habit of growth. The foliage is very dark green. The largest specimens at Highland Park are twenty feet tall. Its cones are much larger than those of the common hemlock. In the autumn, when the branches are loaded with the yellowish-brown cones with the scales fully opened, it is an object of singular beauty. It is perfectly hardy, and requires a cool, moist, well-drained soil.

The Japanese hemlock, *Tsuga diversifolia*, forms a bushy habit in cultivation, with a number of stems. Wilson says it forms a tree eighty feet tall in Japan. It does not attain anything like that height in this country. The conspicuous white lines on the under sides of the leaves contrast very markedly with the dark green on the upper surfaces.

Siebold hemlock, *Tsuga Sieboldii*, from Japan, is not as hardy as *T. diversifolia*. It forms a low bushy tree and does not exceed six feet in height in ten years. It should be planted in a sheltered situation. Wilson says that in Japan, in native conditions, it grows to about the same height as *T. diversifolia*.

Douglas fir.

The so-called Douglas spruce, or red fir of lumbermen, *Pseudotsuga taxifolia*, is another of the few conifers from the

western side of the continent that does excellently in the Northern and Northeastern States. It is, however, the form from the interior that is perfectly hardy in the East. The beauty of the Douglas spruce is difficult to exaggerate. Typical color of the foliage is dark yellow-green, but seedlings often appear with glaucous-bluish foliage. It forms a handsome pyramidal outline. The branches are very irregularly whorled or circled on the stem and it differs very much from a spruce or fir in this respect. Branches are also horizontal, with a slight curve downward in the center, and turn up gracefully at the ends. Occasionally they are slightly divergent. In moist well-drained soil it grows rapidly and attains a height of thirty-five feet in twenty-six years. Douglas spruce planted on porous sandy slopes does not grow as rapidly as in more congenial conditions, but it forms a sturdy dense growth and presents an excellent appearance. A well-developed individual on the edge of a lawn, with plenty of room for spread of branches, is a beautiful object. Var. *globosa* is a low-growing bushy form well adapted to gardening in restricted situations. Var. *pendula*, with the branches drooping at the ends, is highly ornamental. Var. *fastigiata*, with upright branches, forms a narrow pyramid; whilst there is a var. *fastigiata* in the trade, a spontaneous seedling that occurred under the observation of the writer is here particularly referred to.

Spruces.

The spruces are remarkably beautiful trees in parks and gardens when well grown and healthy. Their pyramidal outlines, with the branches commonly arranged in circles or whorls, present a graceful appearance. The spruces, as a rule, are not as well adapted to dry sandy soils as are pines. While nearly all of them will not thrive in cold wet soils, they prefer

a moist sandy loam thoroughly well drained. In native conditions spruces appear to be at home on hill and mountain slopes where moisture is abundant but never stagnant.

Engelmann spruce, *Picea Engelmanni*, native from British Columbia to New Mexico, is a tree of singular beauty. The strictly pyramidal outline, with the branches closely arranged in circles and maintained to the base, renders it particularly desirable for ornamental grounds. The lower branches are maintained under average conditions from forty to fifty years, and it will probably compare favorably with any other spruce in this respect. As far as the writer's observations are concerned, it is very rare for any spruce to maintain all of the lower branches during its entire life, that is, for one hundred years or more in cultivation in the Northeastern States.

The Colorado spruce, *Picea pungens*, native throughout parts of Colorado, Utah, Wyoming, and New Mexico, is perhaps one of the most popularly planted conifers at the present time. In its juvenile state it is very beautiful, with a dense pyramidal outline, but, unfortunately, in twenty or twenty-five years it begins to lose the lower branches, and usually presents an unhappy appearance. The oldest specimen at Highland Park is about thirty years old, and the lower branches from about one-fourth of the stem have died. Amongst the various forms with glaucous, bluish, and silvery foliage, perhaps the var. *Kosteriana* with silvery-bluish foliage is the most distinct. The var. *glauca pendula* has bluish foliage and pendulous branches. This form is so very pendulous that it requires a stout stake when it attains considerable size, to prevent it from tumbling over. The var. *compacta*, a low bush form, is an excellent plant for decorative gardening in formal conditions.

The oriental spruce, *Picea orientalis*, native from the Caucasus

west into Asia, is a tree of remarkable beauty. The small dark green leaves, very much crowded and appressed on the branches, give it a charming appearance. Branches are spreading and ascending, and when in perfect health and vigor are thickly disposed from base to apex. It retains its lower branches as well as any spruce in cultivation in the Northeastern States. The plant partially suffered during the winter of 1917 and 1918, but soon recovered. Near the entrance of Riverside Cemetery, Rochester, New York, are two beautiful groups of the oriental spruce planted thirty years ago. The leader is occasionally attacked by the white-pine borer. A low variety of this spruce is known as *nana*, with wide-spreading branches, very desirable for small gardens.

The Servian spruce, *Picea Omorika*, from the Balkan region, gives much promise. It belongs botanically to a small group of spruces in which the leaves are flat or flattish, and it is the only one in this group of cultural promise in the Northeast. The habit is narrow-pyramidal, with the branches ascending and spreading. The branchlets are often slightly upturned, disclosing the dark green under side of the leaves in contrast with the silvery lines on the upper surface. This spruce requires well-drained, moist, deep, rich soil to be in perfect health. It is quite hardy. The leader is sometimes attacked by a borer.

The flat-leaved spruce from Japan, known as Yeddo spruce, *Picea jezoensis*, after a few years in cultivation looks so unhappy that nothing can be said in favor of its cultivation. When quite young it has a pretty appearance, but, unfortunately, this soon disappears.

The Iramomi spruce, *Picea bicolor*, from Japan, is decidedly promising, but it is rare in cultivation. There are individuals in the Hunnewell Pinetum fifty feet in height and branched to the base, in perfect health and very handsome.

The white spruce, *Picea glauca* (*P. canadensis*), most decidedly requires a cool, moist, well-drained soil to be happy. Under such conditions it forms a dense pyramidal habit. It usually has light green-bluish foliage. The branches are ascending and horizontal, and often the branchlets are pendulous. White spruce is largely planted and often placed in dry sandy conditions where it is attacked by red-spider, and it then presents an unattractive appearance. The writer has often seen it in northern Ontario, Canada, in groves and isolated, sixty to seventy feet in height, the individuals standing alone densely branched to the base, in perfect symmetry, and no spruce could appear more ornamental. A remarkably dwarf interesting form of the white spruce is now known under the name of *P. glauca albertiana conica*. It was discovered by J. G. Jack, of the Arnold Arboretum, near Loggan in Alberta in 1904. It has a distinctly conical habit and is believed not to grow at any time over three to three and one-half feet. This interesting plant is now being distributed by some nurseries and will be very valuable in formal gardening.

The Norway spruce, *Picea Abies* (*P. excelsa*), is perhaps planted more extensively than any other spruce in the Northern and Northeastern States. It is much to be regretted that experience after many years shows it to be unfitted for this country. The greater number of the Norway spruces in this region after twenty-five to thirty-five years begin to go backward. The tree is quite hardy, but the climatic conditions do not seem to suit it. In dry sandy soil it invariably is attacked by red-spider. Occasionally it is seen in adult age in healthy condition in valleys or on slopes in deep, cool, moist, well-drained soil. It is a magnificent forest tree in central Europe. When a quick, effective, evergreen windbreak is desired, provided the soil is fairly moist, it serves this purpose

PLATE XV. Hondo spruce (*Picea jezoensis* var. *hondoensis*)

PLATE XVI. Ground-cover of creeping juniper (*Juniperus horizontalis*)

very well for many years. In adult individuals the branches are stout and spreading, with frequently long pendulous branchlets suspended from the main branches, and in a healthy tree this habit appears highly ornamental. There are a number of pendulous, columnar, and dwarf varieties of the Norway spruce. The dwarf varieties appear to show more virility than the type. The vars. *Gregoryana*, *Maxwellii*, *Ellwangeriana*, *microsperma*, *Clanbrasiliana*, and *nana* have variously formed low bushy and conical habits. They are excellent plants for many situations in ornamental gardening where low evergreens are required. In twenty-five years some of these very slow-growing dwarf forms will not attain over three feet in height.

The black spruce, *Picea mariana*, native from Canada to Virginia, and often abundant in swampy or wet grounds, does not succeed well in cultivation in western New York. After ten to fifteen years it presents an unattractive appearance. Var. *Doumettii* does remarkably well and is very promising. It forms a dense conical pyramid with the branches crowded. In fifteen years it does not exceed nine feet in height. Var. *nana* is a low dense mat, which ultimately assumes a sub-globose habit. It seems to retain health and vigor after many years.

The tigertail spruce, *Picea polita*, from Japan, is one of the most distinct species, with its rigid leaves and stout branches. It requires a moist rich soil and a well-protected situation, and under such conditions it is quite hardy. In some parts of the country it is alleged to lose the lower branches early, but trees in the Northeastern States after twenty-five years are retaining the lower branches remarkably well.

Picea Maximowiczii, from Japan, is a very rare spruce in cultivation. It has short stout leaves and slender branches spreading and ascending, and inclined to be slightly divergent.

It is very slow-growing and in fifteen years does not exceed seventeen feet in height.

Picea Schrenkiana, from Siberia and north China, is quite promising and hardy in a young state. The habit is dense and the leaves are deep green. There are no large individuals of this spruce in cultivation in this country.

The red spruce, *Picea rubra*, native from Canada, northern New York to Pennsylvania and North Carolina, is a handsome tree in native conditions, and of great economic importance. It does not thrive in cultivation and cannot be recommended for ornamental conditions in parks and gardens.

Firs.

The firs are notable objects in parks and gardens, particularly in juvenile conditions. The large characteristic leaves, thickly disposed on the generally horizontal branches, are very attractive. They do not, perhaps, exhibit the graceful appearance of spruces, but in the decoration of parks and gardens they supply a most important ideal, from a different standpoint. Firs require a moist good soil to be in vigorous health.

The white fir, *Abies concolor*, is one of the best in cultivation in northeastern America. The interior form from Colorado is best adapted to planting. In twenty-six years it attains a height of thirty-nine feet, with a distinctly pyramidal outline and branched to the base. The large flat leaves, thickly disposed on the branches, are very noticeable and give it a very dignified appearance. Seedlings vary considerably and frequently show a glaucous-bluish tinge in the leaves. The white fir should be planted in moist good soil, preferably at the base of a slope where abundance of moisture can be supplied, or in a situation in which the soil is porous and moist and well drained.

The Nikko fir, *Abies homolepis*, from Japan, is one of the most important exotic species introduced in this country. The largest individuals are at least forty-five feet in height and in perfect health in some gardens in this country, and densely branched to the base. The tree forms a handsome pyramid, resting on a very broad base. The leaves are large and deep green. This fir has been planted considerably around New York and New Jersey. *A. homolepis* var. *umbellata* is equally hardy and has about the same habit of growth, but the cones are green, whereas in the former they are violet-purple.

Nordmann fir, *Abies Nordmanniana*, native of the regions southeast of the Black Sea, presents a remarkably noble appearance when in good health. The writer has a tender affection for this species because it was the first fir he became acquainted with as a boy in the north of Scotland. The large, very flat leaves are densely crowded on the horizontal branches. Nordmann fir suffered very much in the Pinetum at Highland Park during the very cold winter of 1917 and 1918, being badly browned and losing many leaves. Some have not fully recovered from the injury up to the present time. Occasionally the leaves on the south side will be a little browned from the winter's sun after the middle of February in an ordinary winter. It is a very important fir in the Middle States. In the New England States this species should be planted in well-protected situations.

Veitch fir, *Abies Veitchii*, from Japan, is very hardy and has never shown the slightest signs of winter-injury. In a juvenile condition this fir is very handsome, but when it approaches adult size, it becomes thin in habit. This tendency can be very much obviated by disbudding or removal of the central buds of the branches and occasional stopping of the leader to induce a denser lateral growth.

The Cilician fir, *Abies cilicica*, from Asia Minor, is a handsome species. It suffered considerably during the winter of 1917 and 1918, but recovered in about two years. Many lowermost branches have died, but otherwise it is in perfect health. The largest trees are about thirty feet tall. The grayish-green foliage is very noticeable.

The Cephalonian fir, *Abies cephalonica*, with its sharp-pointed leaves and dense habit of branching, is one of the most beautiful firs where it proves hardy. It is very likely to be badly scorched by the winter's sun in February after a low night temperature. In the winter of 1917 and 1918, some of the largest plants were severely injured, but it can be grown by carefully studying conditions of exposure that may suit it. It is a beautiful tree in the Middle States.

The silver fir, *Abies alba* (*A. Picea*), from the mountains of central and southern Europe, is distinguished by the leaves lying very flat on the branches. It is a very beautiful species and fast-growing where it is perfectly hardy. In the Northeastern States it is a little hardier than *A. cephalonica*, but it suffered considerable injury during the winter of 1917 and 1918. There is a silver fir growing on the Winton Road, east side of the city of Rochester, New York, at least seventy-five feet tall and perhaps sixty-five years old. This is a good illustration of what a tender tree may do when planted in well-protected, favorable situations. There is a dwarf variety of the silver fir which after many years does not exceed two to three feet in height and appears quite hardy.

The Siberian fir, *Abies sibirica*, is very hardy and looks well at Highland Park after fifteen years' growth. It is said to lose the lower branches and appear straggling as it approaches adult size. The crowded leaves have a dark yellowish color.

The Momi fir, *Abies firma*, from Japan, has very rigid, large,

deep green leaves, with horizontal massive branches. At Boston this fir looks bad, but there is a fine individual, perhaps thirty feet tall, in the Park Department Pinetum, Rochester, New York, which is in excellent health and has not suffered any injury.

The balsam fir, *Abies balsamea*, which always looks so attractive in native conditions in northern woods, in this country and Canada, soon assumes a most unhappy appearance in cultivation and cannot be recommended. The low variety of the balsam fir known as *hudsonia* is an excellent dwarf form for gardens and seems to maintain good health.

The red fir, *Abies nobilis*, is perhaps one of the noblest of all firs as it grows in a wild state on the Pacific Coast. After twenty years in western New York, it is only a dense bush six to eight feet tall and does not seem inclined to form a leader and become tree-like. It seems, however, to be quite hardy.

Umbrella-pine.

The umbrella-pine, *Sciadopitys verticillata*, a native of Japan, presents a most singular appearance amongst conifers. There are two kinds of leaves: those on the shoot small and scale-like, but at the end of the branch much longer and linear and forming an umbrella-like circle. The habit of young trees is narrowly pyramidal. Wilson states that in native conditions in Japan the habit is gaunt and thin, and is very different from the dense pyramids to be seen in American parks and gardens. The umbrella-pine should be planted in deep, moist, well-drained soil to appear at its best. It has not been injured in the Northeast in severe winters

Sequoia.

The big tree, *Sequoia gigantea*, is perhaps one of the noblest vegetable organisms on earth. The largest trees in cultivation

on the eastern side of the continent were in the Ellwanger grounds on Mt. Hope Avenue, Rochester, New York. The seeds were brought from California by "Pony Express" in 1854 by Ellwanger & Barry. They raised about three thousand seedlings and most of them were sold in England. Ellwanger & Barry planted a small group near their office and they did remarkably well. The largest individual in 1916 was seven and nine-tenths feet in circumference and fifty-five feet in height. The severe winter of 1916 and 1917 so injured them that two years later they died and have recently been removed. If they were planted out when quite small, which is probable, they therefore were growing exposed to a series of winters extending to about sixty years. The sequoia is, therefore, not to be recommended for ornamental grounds in the northeastern United States.

Taxodium.

The bald-cypress, *Taxodium distichum*, which is not evergreen, is a very lovely tree in cultivation and does remarkably well. It is of pyramidal habit and the slender branchlets, covered with light green feathery foliage, render it a charming tree for parks and gardens. It is very important to plant the bald-cypress in a moist, well-drained, good soil. Although this species grows naturally in swamps, probably if it were tried in cultivation it would be a failure.

Arbor-vitæ.

The common arbor-vitæ, *Thuja occidentalis*, which in a natural state extends into northern Canada, is perhaps one of the hardiest coniferous evergreens and the most abundantly planted. It is planted extensively as a protective hedge. Many of the market-gardeners in Irondequoit, New York, use arbor-vitæ in hedges on the western, northwestern, and northern

sides of areas in which they raise early spring vegetables. When this species attains sufficient size it serves a protective purpose admirably and is used in this way in many parts of the country. The common arbor-vitæ in a wild state is quite variable in its habit, often forming a dense upright pyramid, and frequently with partly spreading branches. There are at least fifty or more varieties of the common arbor-vitæ in cultivation. Some of the larger pyramidal forms are var. *robusta* (var. *Wareana*) with a broad pyramidal habit and deep green foliage which is well retained throughout the winter. Var. *Vervæneana*, with its pyramidal habit and slender branches, is very graceful. The foliage has a faint tinge of yellow, but not conspicuous enough to be disagreeable. Var. *Douglasii pyramidalis* has a narrow pyramidal habit, with short, dense, crowded branches, and is an excellent form in decorative gardening. Amongst some of the best low forms are var. *globosa*, low, spreading and bushy; var. *Ellwangeriana*, a low dense sort which with age becomes slightly pyramidal, and characterized by typical and acicular leaves; var. *Hoveyi*, becoming a pyramidal-shaped bush in which the branches have the appearance of being folded together in layers; var. Little Gem, an admirable low form, which in twenty-five years does not exceed two feet in height and forms a spreading low cushion, retaining a dark green color; var. *Reidii*, a spreading, large, bushy form with smallish leaves, but in time likely to become a little thin.

The canoe-cedar, *Thuja plicata*, native from Alaska to Montana, is, very fortunately, one of the few conifers from the western side of the continent that is promising in the East. The largest individuals in Highland Park are thirty feet tall and branched to the base, and the foliage retains a deep green color throughout the year. It assumes a very graceful pyramidal outline. It should be planted in a moist well-

drained soil. The canoe-cedar is one of the most beautiful conifers in the Pinetum.

The Japanese arbor-vitæ, *Thuja Standishii*, is a very beautiful decorative plant. It has a somewhat broadly pyramidal habit, and the foliage, with a pale green aspect, does not change throughout the year, or only very slightly in winter. The tree requires a moist deep soil to appear at its best.

The oriental arbor-vitæ, *Thuja orientalis*, from eastern Asia, has usually a strictly pyramidal habit. Branches present the appearance of being densely folded together. The foliage is a bright olive-green color which it retains well throughout the winter. Many named varieties are in cultivation, with dwarf, densely columnar, and pendulous habits. About fifteen years ago a quantity of seeds of the oriental arbor-vitæ, collected in China, were given to the writer and several hundred seedlings were raised. They were planted on a steep, moist, sandy slope facing the northeast in Durand-Eastman Park, Rochester. They are now seven to ten feet tall and are nearly all narrowly pyramidal in habit, some much more so than others. The effect of this large group on this slope is excellent.

Cypress.

The Sawara cypress, *Chamæcyparis* (*Retinispora*) *pisifera*, from Japan, is a very popular evergreen in American gardens. The typical form is a beautiful ornamental tree when grown to one stem. The type should be much more widely grown, and as an ornamental it is not surpassed by any of the seminal or vegetative forms that have been produced from it. The Sawara cypress, or any of its varieties, should always be planted in positions well protected from the sweep of the prevailing cold winds in moist good soil. The var. *filifera*, with long slender branches, becomes in time a broad round dome and very deco-

rative. Var. *plumosa* has a very distinct pyramidal outline and, with the plumose branches and branchlets, is very ornamental. Var. *squarrosa*, in which all the leaves are acicular and bluish silvery-green, is a most distinct form and always attracts attention. It is indeed difficult to connect it with the type from superficial observation.

The Hinoki cypress, *Chamæcyparis obtusa*, from Japan, is not nearly as well known in cultivation as *C. pisifera*. It forms a very handsome tree with horizontal branches and the branchlets somewhat pendulous. A few years ago there were trees sixty feet tall on the estate of the late Dr. George Hall, Bristol, Rhode Island. There are a number of varieties of the Hinoki cypress. Perhaps one of the best is var. *nana* with a very dense habit and the branches much crowded together, somewhat in layers. The Hinoki cypress should be planted in moist, well-drained, rich soil.

The Nootka cypress, sometimes known as yellow-cedar, *Chamæcyparis nootkatensis*, native from Alaska to Oregon, forms a very handsome tree with a narrow pyramidal head from a broad base. It is quite hardy and has shown no ill effects in twenty-five years. It requires a moist situation and protection from the sweep of the prevailing dry winds by the lay of the land or otherwise. There are a number of named garden varieties but they are rare in this country.

The white-cedar, *Chamæcyparis thyoides*, native from New Hampshire to northern Florida in cold wet soils, has nothing particularly to recommend it from an ornamental standpoint. It will grow well in ordinary soil, but it is important to plant in soils full of stagnant moisture where nearly all other conifers would perish. The branching habit is usually thin, with a spire-like top.

Junipers.

The junipers are very important in ornamental culture. There are numerous decorative forms amongst them, nearly all of which are suited to light dryish soils.

The so-called red-cedar, *Juniperus virginiana*, is native from Nova Scotia to Georgia and eastern Texas and is widely distributed between these points. It often grows naturally in sandy gravelly hillsides and is excellent for planting in poor sandy soils. The red-cedar is quite variable in its habit, as it often forms a narrow pyramidal tree with the branches erect, or the branches are horizontal and the ends ascending, the general outline being conical. It is extremely hardy and suitable for planting in cold exposures. The red-cedar is said to attain a height of one hundred feet in some native conditions, but it does not exceed forty to fifty feet in cultivation.

There are numerous varieties of the red-cedar and many are excellent decorative garden plants. Var. *glauca* is perhaps one of the most popular forms in gardens. The habit is somewhat loosely pyramidal and the foliage has a delicate bluish cast. Var. *tripartita* is a spreading bushy form with an irregular head which in twenty years does not exceed eight feet in height. It looks very different from the typical red-cedar. Var. *Schottii* forms a low dense pyramid with foliage of a light olive-green color. Var. *Canaertii* is of low, compact, pyramidal habit, with foliage of a dark grass-green color, and appears to be quite distinct from all other varieties in this respect. It has very distinct bluish berries. Var. *venusta* forms a narrow pyramidal column and in twenty years attains a height of twenty-five feet. It has light green scale-like foliage. This is a rare plant in cultivation, and on account of its distinct habit is very desirable for garden decoration. Var. *pendula* is the most graceful form for the garden. The habit is somewhat spreading and the

branchlets pendulous. There is an excellent specimen of this variety in the Arnold Arboretum. Var. *Kosteriana* forms a wide-spreading bush and bears a strong resemblance to the variety of the Chinese juniper known as *Pfitzeriana*, the general branching habit of both forms being much alike. Var. *Kosteriana* in time will probably not exceed five feet in height, and with its graceful spreading branches it is a most important decorative plant for gardens. A low prostrate form of the red-cedar, which is said not to grow more than eighteen inches high on some cliffs on the coast of Maine, has been introduced to the Arnold Arboretum. If it retains this habit in cultivation, it will be a most important low juniper. At the annual meeting of the New York State Horticultural Society, January, 1923, at Rochester, an excellent display of coniferous and other evergreens was made by the State Agricultural College, Cornell University, in charge of Ralph W. Curtis. He showed a low, dense, bushy form of the red-cedar which he discovered growing on the hills a few miles north of Ithaca. It was not more than two feet high and was evidently an old plant. Curtis has named it provisionally *nana*, and as this name does not seem to appear in any cultivated forms of the red-cedar, it will probably stand. This will likely become an important plant in gardening.

The Chinese juniper, *Juniperus chinensis*, native of northeastern Asia, in the typical form does remarkably well in cultivation. The habits of the pistillate and staminate forms are quite distinct; the staminate is more robust and faster growing, with a pyramidal habit; the pistillate or fruit-bearing form has a looser habit and evidently does not grow so large. The brownish-yellow fruit is very attractive throughout the winter months. Many species of junipers have two types of leaves—scale-like and acicular (needle-shaped). This is marked in the Chinese juniper. Var. *Pfitzeriana* is one of the most

important decorative junipers in cultivation at the present time. It is one of the best low conifers to plant close to the walls of a house, and, if given room to develop, adds much dignity to a home. The branches spread out almost horizontally and in time form a large irregular bushy head six to eight feet tall. The branchlets at the tips of the branches are pendulous and the foliage is light olive-green. Var. *columnaris* is a form introduced to cultivation by the United States Department of Agriculture, through the late F. N. Meyer. It forms a distinct narrow pyramid and all the leaves are acicular. The foliage is light bluish-green and is remarkably decorative. Var. *Sargentii* is a low-spreading shrub which does not exceed one foot in height and forms dense mats ten to twelve feet in diameter. Amongst the low-spreading junipers, this is one of the most important for covering banks and slopes, and is useful in rock-gardening. It does remarkably well in poor sandy soil, by cultivating and mulching for two to three years to get the roots well established. Var. *albo-variegata* forms a low dense pyramid with the tips of the branches silvery-white. The white coloring is not sufficiently prominent to be disagreeable.

The savin juniper, *Juniperus Sabina*, which is native throughout many parts of the northern hemisphere, has a low erect habit of growth, and will in time attain a height of six to eight feet. The usually imbricated leaves are quite dark green. Planted four to five feet apart, it forms an excellent border to larger evergreens in the background. It is also valuable for planting at the angles and corners of cement steps winding up steep slopes. It is not fastidious about soil conditions and does well in light, sandy, poor soils. Var. *tamariscifolia*, a geographical form from southern Europe, has a spreading or procumbent habit and appears to be quite different from the type. It is an excellent prostrate juniper and has a most

agreeable bright green color. The leaves commonly are needle-shaped. It is excellent on banks and slopes.

The horizontal juniper, *Juniperus horizontalis*, is widely distributed in North America in native conditions. It is often found on sand-dunes, and in western New York, in Genesee County, it grows abundantly in Bergen Swamp with its roots in the water. The horizontal juniper has long prostrate stems which cling closely to the ground and is one of the best for banks, rocky slopes, and rock-gardening. Var. *Douglasii* is a very low trailing form with bluish foliage which assumes a purplish tinge in the autumn. This is often sold in the nurseries as Waukegan juniper. In twenty years it will form a low mat twelve to fifteen feet across.

The common juniper, *Juniperus communis*, widely native throughout northern parts of the northern hemisphere, is rare in cultivation in this country. Its typical tree form, with branches forming an irregular open head and ten to twenty feet tall, is said by Sargent to be occasionally found in New England, eastern Pennsylvania, and on the high mountains of North Carolina. The writer remembers seeing it as a boy, quite common on the hillsides in the north of Scotland as a tree of considerable size. Var. *depressa* is the common low form sold in nurseries and is abundant in rocky ground and poor soil in the St. Lawrence Valley, New England, and northern Ontario and Quebec. In several forms this juniper is rather commonly cultivated and is valuable for rocky banks and slopes. Planted three to four feet apart in a massed border, it forms an excellent frontage to a group of larger conifers. The habit is low branching, and in time it forms stout recumbent stems. It seldom exceeds three feet in height and usually it is not over two feet. There is a var. *aurea* with bright golden-yellow foliage which is quite striking. Var. *oblonga*, with an

upright slender habit and branches slightly diverging, is a very decorative plant. The Irish juniper, var. *hibernica*, and the Swedish juniper, var. *suecica*, suffer in severe winters. The former has a strict, narrow, columnar habit. The Swedish juniper is also quite narrowly upright, but the ends of the branchlets droop slightly. Both of these junipers are likely to be pulled apart and their prim stiff forms much injured by heavy snowstorms. It is necessary to support them with stout iron poles driven deeply in the ground and kept out of sight in the interior of the mass. When tied securely outside the branches they resist the destructive tendencies of heavy snowstorms, and the poles are left undisturbed throughout the year.

Juniperus rigida, native throughout various parts of northeastern Asia, bears a strong resemblance in its foliage to the common juniper. As it grows in the Arnold Arboretum, perhaps twelve to fifteen feet tall, it is highly ornamental with an ascending loose pyramidal habit and the branchlets pendulous at the tips. Experience seems to show that it requires moist good soil to do well.

Juniperus squamata, from western China and the Himalayas, is a low form with prostrate stems and scale-like, linear, much-crowded leaves, grayish-green, with two white bands above. This juniper is likely to suffer in a very cold winter, unless it is buried in snow. At one time the late Timothy McCarthy, superintendent of Swan Point Cemetery, Providence, Rhode Island, used *J. squamata* in large quantities as an edging for rhododendrons and also as a mass against groups of stone bowlders, with excellent effects. Var. *Fargesii* is an arborescent form said to attain a height of seventy feet in western China. The plants in Highland Park are still small, but they show a tree habit and appear to be quite hardy in an exposure of several winters.

Juniperus conferta, introduced by Wilson from Japan in 1915, is a littoral species and forms dense mats on sandy shores. The deep green leaves are densely crowded, straight, and pale green beneath. It shows a tendency to be tender.

Torreya.

Torreya nucifera is a very distinct yew-like plant from Japan. There are several species of Torreya but *nucifera* is the only one fairly hardy at Rochester, New York, and it must be planted in a situation well protected from the sweep of cold winds. The habit is spreading and bushy, and the two-ranked, deep green, lance-shaped leaves are very ornamental.

Yews.

The Japanese yew, *Taxus cuspidata*, is the most important foreign evergreen ever introduced to this country. The rich dark green foliage, which is maintained without loss of color throughout the entire year, renders it a valuable acquisition for gardens and parks. It was introduced in 1862 and has, therefore, been a sufficient time in cultivation to warrant an opinion on its merits. It passes through the severest winters without injury. Fortunately, the Japanese yew is now propagated in many American nurseries and is becoming well known in many gardens. The seedlings show much variation, some having a distinctly arborescent habit, that is, growing to one tree-like stem, which may be encouraged by a little pruning of the side branches to develop the tree habit. Most of the seedlings grow into various bush-like forms with wide-spreading branches, and others seem inclined to form low bushy pyramids.

The form of the Japanese yew commonly seen in parks and gardens is a spreading bush with its branches horizontal and ascending at the ends, fifteen to twenty feet across and five to six feet high. It has been known as *brevifolia* but is now

called *nana*. There are, however, in gardens large, broad, bushy forms that are quite different from *nana* and are not distinguished by any varietal name. A low variety, *densa*, makes a compact, round, spherical bush. *Taxus Hicksii* originated in the Hicks Nurseries, Westbury, Long Island. It forms a narrow pyramidal head and gives promise of being an excellent decorative plant. The tree form of the Japanese yew is very desirable, and a beautiful object on a lawn.

The so-called English yew, *Taxus baccata*, which is native in Europe and parts of Asia, cannot be compared to the Japanese yew in hardihood. In severe winters it is likely to brown badly, and sometimes branches are killed; in such instances it is usually late in summer before the specimens recover to look presentable. The English yew is a most beautiful evergreen in any part of this country where it proves hardy. Var. *repandens* almost approaches the Japanese yew in hardihood. It is a low-spreading form in which the tips of the branches turn downward. The leaves are dark green with a slightly glaucous tinge. Var. *Washingtoni* forms a large spreading bush with the leaves lightly tinged yellow, and seems to be hardier than the type. Var. *adpressa* has short, abrupt, olive-green leaves, forms a low irregular bush, and is fairly hardy. Var. *erecta*, an upright bush six to seven feet in height, has been browned in winter several times but has always recovered. Anyone who attempts to grow various forms of the English yew in this country should be cautious to plant them in a situation well protected from the sweep of the cold winds and one sheltered by some means from the sun in late winter.

The Canadian yew, *Taxus canadensis*, native as an undergrowth shrub from Newfoundland to Virginia, is often known commonly as ground-hemlock. In damp woods it produces a

charming effect with its spreading branches covered with the rich dark green leaves. It does remarkably well in cultivation in open exposures, provided the roots are thoroughly mulched and kept cool. The leaves, however, assume a very different appearance, becoming somewhat smaller and shorter and not having the dark green color they show in native shady conditions.

Ginkgo.

The ginkgo or maidenhair tree, *Ginkgo biloba*, probably a native of China but never positively found in the wild state, is one of the interesting trees of the world. The fern-like leaves are deciduous. It is said to attain a height of one hundred feet in gardens and temple grounds in Japan and China, and presents a majestic appearance in old age. It was introduced to the United States and planted in Philadelphia in 1784. It is now a fairly common tree in many gardens and parks throughout the country and is perfectly hardy. In a young state it is likely to be very aberrant in its branching habit, that is, some branches will grow erect and others will strike out at right angles from the stem, and some trees present a rather grotesque aspect with such a contrariety in branching habits. However, with age and as the trees begin to assume adult size, the branching becomes much more regular. There are trees in Rochester that perhaps were planted sixty years ago and are now of considerable size in which the branches are now thickly and regularly disposed, and they are of much interest. Var. *fastigiata* is a narrow pyramidal form in which the branches are strictly upright, and is well adapted to formal situations. Sometimes this fastigiate form will throw out aberrant branches and these should be promptly removed if it is desired to maintain the narrow habit.

EXPERIENCES WITH CONIFERS IN SOUTHERN CONNECTICUT.—Brett

The site on which the following coniferous evergreens are grown is an exposed hilltop, three hundred feet above the Sound and about five miles from the water. The soil is thin, never more than a foot deep, with a subsoil of bowlder clay of extreme hardness called locally "hardpan," almost impervious to water and breakable only by the pick or dynamite.

The firs are difficult to establish under these conditions and the losses have been large, fully fifty per cent in the case of *Abies concolor*, and with smaller losses in some of the other varieties. *A. concolor* does well when once established, specimens after barely holding their own for two or three years afterward making an annual growth of eight to nine inches and forming perfect-shaped trees. *A. Veitchii* is the least satisfactory of the firs in this location, the upward growth being very small and the lower foliage becoming unsightly. *A. Nordmanniana* and *A. homolepis* are more satisfactory than *A. Veitchii*, the annual growth being six inches or more and the trees making otherwise a satisfactory appearance, except that *A. homolepis* tends to lose the lowest branches as time goes on.

The hemlocks are also somewhat unsatisfactory in such a location. All varieties purchased from nurseries have perished and only *Tsuga canadensis*, transplanted from the wild, has succeeded. Even here the losses have been large, fully fifty per cent, as the tree is intolerant of wind and needs shade through the first few years. The situation is exposed to very severe winds from the north and northwest throughout the autumn, winter, and well into the spring months, and the hemlock seems to resent these conditions. Even when planted with specially prepared windbreaks, the losses have been quite large.

The common juniper is wild throughout western Connecticut. The type, however, is very rare, and most specimens are *Juniperus communis*, a dwarf bush usually not exceeding three feet in height and very often six to eight feet across in perfect specimens. It is very easily transplanted, preferring dry situations, will not prosper except in well-drained soils, and can be planted to great advantage on rocky hillsides. As winter comes on, the tips of the new foliage present a pinkish appearance and make a very beautiful picture.

The red-cedar, *Juniperus virginiana*, is not planted as an ornamental tree nearly as much as its merits deserve. Easily transplanted at almost any season of the year from the hillsides and abandoned fields in which it grows abundantly, it becomes, under cultivation and care, a handsome tree with a bright full foliage, and is useful for planting along roadsides and for hedges and for blocking out unsightly objects in the landscape. It is not a fast grower as compared with some of the pines and spruces, but makes, under favorable conditions, an annual growth of about eight inches. There are numerous forms in young trees, some being May-pole shafts twenty feet in height, not more than two feet broad anywhere, and covered with dark green foliage from the ground to the top of the tree. A group of these trees with their, in many cases, spire-like heads, makes a beautiful picture against the winter sky. In later years the branches have a tendency to spread and in picturesque old age become horizontal and even drooping, the tree then requiring much more room, but young specimens retain their shape for many years and can be used in formal planting and for numerous other purposes. In young trees the foliage of native specimens often rivals *J. virginiana* var. *glauca* in color and retains this bluish tinge for many years, the foliage of such trees being usually finer than that of the type. The red-cedar

is easily grown from seed but requires shade for the first two or three years, as is the case with most seedling conifers.

The most satisfactory spruce for exposed situations is, without doubt, the native white spruce. It is not quite so rapid a grower as the Norway spruce, but makes an annual growth of usually not less than one foot, and its handsome blue-green foliage is much denser than that of the Norway. It is one of the best trees for a windbreak or for dense hedges. This spruce, however, should not be grown in sheltered positions or anywhere where the summers are extremely dry and hot.

The Norway spruce is the quickest grower of all the spruces, some trees going upward at the rate of two feet or even more a year. Like the native black spruce, however, the foliage, especially of the lower branches, tends to become ragged and unsightly, and the side of the tree exposed to the severe winds of winter is nearly always less dense than its southern aspect. This is also true of the black spruce which suffers as an ornamental tree also by reason of its persistent cones, which give the tree a moth-eaten ragged appearance.

Picea pungens, both in the *glauca* and green varieties, and *P. Engelmanni*, are slow growers, seldom making more than six inches of upward growth a year. They appear to have no insect enemies, but *P. Engelmanni*, the Douglas spruce, and some of the firs frequently lose their leading shoots, apparently from the perverse habit of the birds which perch on the young and tender leaders and sway back and forth in the winds of early spring. However, in the spring of 1923, Douglas spruce was attacked by immense numbers of aphis feeding on the new growth. Several sprayings with fish-oil soap were required to combat this pest. Lime and sulfur were also tried, but had a tendency to burn the needles.

The Black Hills spruce is a very satisfactory tree, with an annual growth of nearly a foot. Its perfect deep green foliage, interspersed with the white inner surface which shows on the new growth, makes a most pleasing picture. It seems to be hardy under all conditions and to have no insect enemies.

Picea bicolor is very tender and a very slow grower. The leading shoots again and again suffer in the late spring frosts, the trees otherwise appearing to be perfectly healthy.

With the white pine practically eliminated from planting by the many insect enemies to which it is now subject, except in plantations in which it can be nursed and sprayed with care, the Scotch pine becomes the most rapid grower and the best species to use for covering waste spaces, for windbreaks, or for blocking out inequalities of the landscape. Very variable in habit, some of these trees have a tendency to spread in a most ungainly manner, horizontal branches being thrown out equal in length to the height of young trees, while others assume a pyramidal form or develop a round-topped head and retain a satisfactory appearance for many years. Apparently free from insect enemies, the Scotch pine will grow under any conditions, not minding extreme dryness or even water conditions at the roots such as would be fatal to most other pines that can be planted safely in the North.

Pinus Cembra is a very slow grower, only about two inches of upward growth being the average of several specimens, the tree being otherwise perfectly healthy.

Pinus resinosa is one of the most satisfactory pines, being apparently without enemies and having a vigorous growth, not usually averaging more than a foot a year, however, against the two feet or thereabouts of the Scotch pine. This species will not grow when planted in a swamp, as is stated by some authorities.

The Austrian pine is another very satisfactory species, growing about equally as fast as *P. resinosa*. The Scotch, *resinosa*, and Austrian pines are all excellent trees for field planting and for covering waste spaces and rocky, worthless land.

The white pine, the Bhotan, and some other of the soft-needle pines suffer severely from the pine weevil, and unless constant care is taken and the trees are given frequent spraying, these trees lose their leading shoots and become mere bushes, presenting a ragged and unsightly appearance and are, of course, then useless for timber purposes. These trees, together with *P. Banksiana* and *P. Cembra*, also suffer severely from a comparatively new insect enemy, the imported sawfly, the larvæ of which, almost as numerous on these trees as the so-called tent-worm is on the wild cherries, denude the trees of their needles, and, as there are several broods a year, the new growth in its turn is destroyed, so that the tree eventually dies unless it is saved by spraying or other methods. On young trees, the best plan is to crush the caterpillars with the hands, gloved or otherwise, as they appear, but this requires constant watching throughout the summer because of the several broods. Another recently discovered enemy, but attacking only the white pine, is the pine-tube builder, which also feeds on the foliage, but is not, so far, a very serious menace.

Pitch pine and *P. ponderosa* are among the very slow growers in this locality, some trees, ten to twelve years of age, having attained a height of only six to seven feet in this period.

The yew deserves to be much more widely grown for ornament than is now the case. Free from enemies, a fairly rapid grower, it can be used for many purposes. It makes excellent hedges, stands pruning well, and the bright red berries contrasted with the deep green foliage make these shrubs in the autumn a most beautiful picture.

EVERGREEN CONIFERS IN CANADA.—Macoun

Vast areas in Canada were at one time covered with an evergreen coniferous forest, and over other very large tracts there was a mixture of evergreen and deciduous trees in which conifers were still a very important part of the forest. In addition, in the more southerly parts of the province of Ontario, the hardwoods were the prevailing trees, with a comparatively small proportion of evergreens. While the lumberman's axe and the forest fires have destroyed thousands of square miles of fine evergreens, yet there are still great coniferous forests in Canada, fine woodlands of mixed timber, as well as those other districts in which there are just enough evergreens to make a pleasing variety in the landscape. Canada is looked on by many as the land of the pine and the hemlock, whereas, in reality, it possesses many kinds of trees. The evergreen is, however, a great asset because of its value for lumber and pulpwood, but it means much to the average citizen apart from this. As a shelter from the winds of winter, a windbreak of evergreens is most desirable and is particularly appreciated in parts of Canada where high winds are frequent, and especially on the prairies, where the cold is so intense. A windbreak of conifers is a veritable haven of shelter for the farmer and for his flocks and herds. Not only do evergreens afford this shelter from the wind, but their very greenness in winter makes the landscape much more cheery during the months of frost and snow. When used as specimens or in groups on the lawn, conifers are very effective in beautifying the landscape. As hedges, evergreen conifers are among the best trees and should be much more widely used for this purpose.

The pines.

The pine is closely associated with the name of Canada.

It is one of the most important timber trees, and many million feet of Canadian pine lumber have been sent to other lands. In this connection, however, the pines are given in order of their usefulness as ornamental trees in Canada, the native species being dealt with first.

While there are nine native species, the white pine, *Pinus Strobus*, is the most important commercially and also the best for ornamental purposes. It is wild in the provinces of Manitoba, Ontario, Quebec, Nova Scotia, New Brunswick, and Prince Edward Island, and has done well when introduced in British Columbia, but is not hardy on the prairies. It is the most attractive pine grown in Canada, the graceful outline of the tree, the soft leaves and their lively color helping to make it a very ornamental species. This pine has made an excellent hedge plant at Ottawa, a hedge planted thirty years ago still being in excellent condition.

The western white pine, *Pinus monticola*, makes a fine large tree. It is a native of southern British Columbia and grows there at an elevation of about 6,000 feet. While not so graceful as the white pine, being a closer or more upright grower, it makes a good ornamental, and is succeeding very well at Ottawa, Ontario.

The red pine, *Pinus resinosa*, is found in the same provinces of Canada as the white, but is not nearly so common. As an ornamental tree it has proved somewhat disappointing in places, because of its tendency to become rather ragged in appearance after the first fifteen or twenty years. Its foliage, also, is somewhat dull in color. It is not as attractive as the Austrian pine, which it resembles somewhat, although it is hardier than that species.

Western yellow pine, *Pinus ponderosa*, is a native of the drier districts of British Columbia, and is a magnificent tree

PLATE XVII. Spanish fir (*Abies Pinsapo*)

Dwarf Hinoki cypress (*Chamæcyparis obtusa* var. *nana*)

Sawara cypress (*Chamæcyparis pisifera*)

PLATE XVIII. Small conifer forms

when growing either under forest conditions or as single specimens in that province. It does well when planted in Ontario and makes a fine ornamental and lawn tree, its massive appearance giving it quite a distinct character. The bark of the trunk is also striking. It bears some resemblance in a general way to the Austrian pine, but can be readily distinguished by its having leaves in clusters of three. When obtained from the coldest part of its range, this tree proves hardy in places on the prairies.

The lodge-pole pine, *Pinus contorta* var. *latifolia* (*P. Murrayana*), is a very useful ornamental species for the prairie provinces because of its hardiness. It resembles the Banksian pine very closely, but is more ornamental, the tree having the appearance of being better clothed with foliage. The cones are also persistent as in that species. It is a native of the foothills and mountains from Alberta in the east, to the west coast, and varies much in different parts of its range. It does well when planted in eastern Canada, where, however, it is little used because of more ornamental species hardy there.

Banksian pine, *Pinus Banksiana*, commonly called the jack pine, is found wild on poor, light soils in Canada from the Atlantic west to the Rocky Mountains. It has little value as an ornamental tree, as it has the appearance of lacking foliage, but is useful to the prairies as being one of the few species that can be grown there.

Pitch pine, *Pinus rigida*, is a native of eastern Canada, although not a common tree there, and is one of the few three-leaved pines in this country. It is not of particular value as an ornamental, not being very attractive in outline.

The limber pine, *Pinus flexilis*, is a small, not very ornamental tree, native of the foothills and Rocky Mountains of southern Alberta and British Columbia. It helps to make a

greater variety of evergreens on the prairies where it is hardy, but apart from this would seem to have little value for ornamental purposes.

Whitebark pine, *Pinus albicaulis*, is a native of the timber limits of Alberta and British Columbia, where it is but a small scrubby tree. So far as known, it has not been tested on low elevations for ornamental purposes.

While not having as wide an adaptability as some species, the Austrian pine, *Pinus nigra* var. *austriaca*, is, perhaps, the most ornamental exotic pine which thrives in Canada. It can be grown successfully in the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Prince Edward Island, and in British Columbia. It is a handsome tree and makes a good lawn specimen, though not as graceful as the white pine.

Scotch pine, *Pinus sylvestris*, is hardier than most exotic species and trees twenty-five to thirty years of age may be found on the Canadian prairies, and here it is proving more useful than in eastern Canada where the tree does not become so shapely as some other species. The Scotch pine varies much in growth and shape, depending on the source of the seed from which the trees are grown.

Mountain pine, *Pinus Mugo*, and particularly the dwarf variety known as *Mughus*, makes a very attractive bushy tree and is always much admired. It succeeds well in eastern Canada and can be grown in some places on the prairies.

Swiss stone pine, *Pinus Cembra*, although one of the slowest growing of all pines hardy in Canada, is one of the most ornamental. It is suggestive of a columnar-shaped white pine, being very upright in growth, which makes it suitable for situations in which a tree is desired that shall not take up too much space. It is very hardy and succeeds in all the provinces of Canada.

While the Korean pine, *Pinus koraiensis*, has been little planted in Canada as yet, and is a rather slow grower, it is a very promising species for ornamental purposes. At Ottawa, a tree planted in 1896 is about twenty feet in height, and next to the white pine is, perhaps, the most ornamental species in the Arboretum. It is a five-leaved pine, heavier in appearance and darker in foliage than the white pine, and is strongly recommended for trial in eastern Canada.

Few trees of *Pinus Peuce* are to be found in Canada. It is proving quite hardy at Ottawa, and, planted in 1896, has made a compact, attractive tree about twenty feet in height. It is a rather slow-growing five-leaved pine, rather upright in habit and of bluish-green appearance, and, while not as ornamental as *P. Strobus*, *P. Cembra*, or *P. koraiensis*, the best three five-leaved pines for eastern Canada, it is a useful species.

Additional species doing well, at least when young, in the coast region of southern British Columbia, including Vancouver Island, where the winters are very mild, are: *Pinus Ayacahuite*, *P. Coulteri*, *P. densiflora*, *P. Jeffreyi*, *P. Massoniana*, *P. cembroides* var. *Parryana*, *P. radiata*, *P. Sabiniana*, *P. Torreyana*. No doubt other species not yet thoroughly tested will be found quite hardy.

Cunninghamia lanceolata, which is closely related to the pines, has been under test on Vancouver Island for several years and is doing fairly well.

The spruces.

The spruce is a very important tree in Canada, as a large proportion of the great quantities of pulpwood cut in this country is spruce, and much lumber is manufactured from it. It is valuable for ornamental purposes also. There are five species in Canada, the white, black, and red in the east, and the

Engelmann and Sitka spruces, and also the white, in western Canada. Of these, the most ornamental are the white and the Engelmann. The following species are given in order of their relative value as ornamental trees, beginning with the most useful.

White spruce, *Picea glauca*, is wild in every province in Canada, and is particularly useful in the prairie provinces where so few evergreens are hardy. It is a rapid-growing tree of attractive form. The foliage of the bluest specimens almost rivals that of the bluest forms of the Colorado spruce and, if it were not for the serious insect pests which attack it in eastern Canada, it would be the best spruce to plant for ornamental purposes, but it is frequently rendered very unsightly by attacks of the spruce gall-louse and budworm.

Black spruce, *Picea mariana*, is a much slower grower than the white and is more upright. It is wild mainly in the swampy lands of eastern Canada and in the prairie provinces northward. Though not nearly as attractive as an ornamental tree as the white spruce, its characteristic form and persistent cones give variety and, being very hardy, it is also useful in the coldest parts of Canada. The var. *Doumetii* is a pyramidal sort of striking color.

Red spruce, *Picea rubra*, is seldom met with as an ornamental tree, as it is not nearly so attractive as the white spruce with which it grows in eastern Canada. The leaves have none of the bluish tinge which makes the white spruce so attractive and it resembles the Norway spruce in color, although not so graceful a tree as that variety.

For nearly thirty years the Engelmann spruce, *Picea Engelmanni*, succeeded well at Ottawa and has now reached a height of about thirty feet, but the leaves and branches are dying from the base up and the trees are becoming very un-

sightly. This species is a native of the mountains and particularly the mountain valleys of Alberta and eastern British Columbia and, though enduring severe winters there, is evidently not suited to the climatic conditions of the low altitudes in eastern Canada. It is of a fine pyramidal form, and, when young, the trees are very attractive. As with the Colorado blue spruce and the native white spruce, the color varies from greenish- to steely-blue.

Sitka spruce, *Picea sitchensis*, is a fine tree, native to the western coast regions of Canada where it reaches a large size and is very valuable for timber. It makes a good ornamental subject also, the foliage being particularly attractive, but, in a part of Canada where so many ornamental evergreens succeed, it is not prized as much as a lawn tree as it otherwise would be. It is not hardy in eastern Canada.

The Norway spruce, *Picea Abies*, is the most generally planted for ornament and for windbreaks in eastern Canada. It is a very rapid grower and soon becomes an attractive object on the lawn or quickly makes protection from wind. It is useful for hedges also. While the stock usually supplied by nurseries is not hardy on the Canadian prairies, it does fairly well when seed is obtained from the coldest districts in which this spruce is native. At Ottawa, most trees of Norway spruce planted thirty-three years ago are still fine specimens, well clothed with foliage, though some are now becoming ragged. In other places in the province of Ontario good trees considerably older than this may be found. There are many horticultural varieties of this spruce, most of those listed by nurserymen having been tested at Ottawa. The best of the larger growing forms is var. *pyramidata*, which makes a handsome pyramidal-shaped tree, closer in habit than the type. Some of the pendulous forms are attractive for a time, but are

likely to become ragged. There are many dwarf or semi-dwarf varieties which are quite attractive. Among the best of these are *compacta*, *Remontii*, *Clanbrasiliana*, and *pygmæa*.

Next to the Norway, the Colorado spruce, *Picea pungens*, is the most planted in Canada of the species not native. It is hardy in all the provinces, succeeding very well on the prairies. The variety with steely-blue leaves, known as *glauca*, is the most popular, and this is, as a rule, the only tree thought of when this species is mentioned, unless it be the form known as *Kosteriana*, which is of a particularly fine bluish color. This variety, which is usually grafted, needs to be watched when young and a leader trained, as it often takes a sprawling habit for a time unless this is done. While the Colorado spruce makes a handsome though rather rigid-looking specimen when young, in eastern Canada when it is twenty-five to thirty years old the foliage and branches die from the bottom up, and in a few years they become so unsightly that they have to be removed. However, they are well worth growing for the first twenty years or more, and some specimens at Ottawa over thirty years old are still in fine condition.

While *Picea Omorika* is not well known in Canada as yet, it promises to be a very useful ornamental species, at least in the eastern provinces. It is hardy at Ottawa and makes a handsome though rather slow-growing tree. There is a pleasing contrast in the leaves, which are glossy and dark green on one side and with lines of white on the other.

Picea jezoensis, often sold under the name of *Abies Alcockiana*, while hardy so far as the terminal growth is concerned, usually has many dead branches in eastern Canada, which prevents it from being as attractive as it otherwise would be. There is a marked contrast between the deep green of the lower side of the leaf and the silvery-white of the upper. It

should be more satisfactory on the west coast. The var. *hondoensis* has made a better specimen tree, being much more clothed with foliage than the species.

Picea Schrenkiana is an attractive looking spruce of pyramidal habit and quite hardy at Ottawa. The foliage, while rather dull in color, is quite distinct from other species. It is uncommon in Canada as yet, but is well worth having where one has room for a number of species.

Picea obovata is much like the many small-leaved and slow-growing varieties of Norway spruce and has been called a variety of it. The cones are, however, much smaller than those of the Norway spruce. It is hardy at Ottawa.

Some specimens of the small-foliaged *Picea orientalis* have proved hardier than others at Ottawa. In most cases it has killed back considerably and is not satisfactory on the whole.

The Douglas fir.

Douglas fir, *Pseudotsuga taxifolia*, is one of the most valuable Canadian trees. It reaches a great size in British Columbia, where it is native, and it grows also in Alberta in the Rocky Mountains. Its use as a timber tree is well known, but where it is native it is not prized as an ornamental, except that huge specimens are admired in the parks or native woodlands. In eastern Canada, however, where it has been planted for ornament, it has proved to be very desirable. After thirty years it is better clothed with foliage and branches at Ottawa than almost any other conifer, and from this experience it is highly recommended. Trees are now nearly fifty feet in height. It is important when growing this tree in eastern Canada to obtain seed or plants from the colder or interior parts of its range. If obtained from the west coast, it will not do well. The color of the foliage varies considerably.

The firs.

The firs are not so valuable as the spruces for ornamental purposes, for although attractive in eastern Canada when young, they lose many branches and become ragged-looking later on. In the coast regions of British Columbia, however, they succeed particularly well and make fine ornamental specimens for many years.

The balsam fir, *Abies balsamea*, is a rapid-growing tree which is quite attractive when young, with its deep green glossy foliage, and is useful for temporary effects in the landscape. When grown in the open, however, it becomes rather unsightly after being planted twenty to twenty-five years, and at Ottawa many specimens have died about this age.

While some specimens of alpine fir, *Abies lasiocarpa*, have killed back at Ottawa, most have proved hardy. Much depends on the source of the plants or seed from which they are grown. It has a denser habit of growth than *A. balsamea* and promises to remain well clothed with foliage for a longer period. It is wild in the Canadian Rocky and Selkirk mountains, and east of the mountains in the Peace River district.

Lowland fir, *Abies grandis*, is a native of the west coast of Canada and grows to be very large there. When given abundance of room it makes a fine ornamental tree. It does not succeed in eastern Canada.

White or amabilis fir, *Abies amabilis*, is native in the coast regions of British Columbia and is not hardy in eastern Canada. Its habit is more pendulous than that of most species.

White or silver fir, *Abies concolor*, is the best ornamental species in eastern Canada. Some forms are almost or quite as blue as the Colorado spruce and, because of its more graceful or less stiff outline, is more attractive than that spruce. It is one of the most beautiful evergreens hardy in eastern Canada.

PLATE XIX. Lawson cypress (*Chamæcyparis Lawsoniana*)

PLATE XX. American arbor-vitæ (*Thuja occidentalis*). Left, var. *Buchananii*. Right, var. *Columbia*

Nordmann fir, *Abies Nordmanniana*, is a useful ornamental tree for the west coast. The dark green glossy leaves with the silvery-white of the under side give it a very striking appearance. Specimens from coldest districts are worth trying in eastern Canada.

Siberian fir, *Abies sibirica*, is quite hardy at Ottawa but looks best when young. The foliage is of a lighter green than that of most other firs. It is more useful for temporary than for more permanent planting.

Like the other firs, Veitch fir, *Abies Veitchii*, looks best when young. The foliage is attractive, being deep green above and silvery below, making a fine contrast. This is comparatively hardy at Ottawa, but loses some of its branches from winter-injury. It also is more suitable for the west coast.

Additional species succeeding in the coast region of southern British Columbia, including Vancouver Island, are: *Abies cephalonica* and var. *Apollinis*, *A. homolepis*, *A. cilicica*, *A. nobilis*, *A. alba*.

The arbor-vitæ.

The American arbor-vitæ is one of the most useful trees in eastern Canada, and in British Columbia the western arbor-vitæ, *Thuja plicata*, is also very valuable. Not only is the American arbor-vitæ one of the most durable so far as the wood is concerned—and it is particularly valuable for fence, telegraph, and telephone poles—but it makes the best evergreen hedge plant for eastern Canada and is one of the most ornamental lawn trees when given room for full development.

While the ordinary wild type of American arbor-vitæ, *Thuja occidentalis*, makes a well-shaped and attractive specimen tree, there are many horticultural forms which give great variety to the landscape. Many of these have been tested at

Ottawa during the past thirty years, and some have been found much more satisfactory than others in their ability to withstand climatic conditions. Among the best of these are: *Douglasii pyramidalis*, an attractive pyramidal variety, not so narrow or columnar as *fastigiata*. It has very distinct foliage and is one of the hardiest forms. Because of its general soft appearance, caused by its small foliage, and on account of its having withstood severe tests well, *Ellwangeriana* is one of the most satisfactory as a lawn specimen. It is really a semi-dwarf with broad outline, and after thirty years is only about fifteen feet high at Ottawa. *Globosa* is another reliable variety, well named, as its outline is almost globose. This also is a semi-dwarf, being only six feet high after thirty-three years at Ottawa. It has never been injured by winter. Var. *fastigiata* or *pyramidalis* is usually known as the pyramidal arbor-vitæ and is one of the most striking hardy evergreens. It is quite columnar in habit—specimens at Ottawa thirty feet in height are but six feet across at the base. Occasionally limbs of this variety are injured in winter, but, as a rule, it is quite hardy. Var. *Vervæneana* has proved reliable. It is more graceful in habit than the species and a slower grower. It has yellowish foliage which is not quite definite enough to make it specially attractive on this account. Var. *robusta* or *Wareana*, often called the Siberian arbor-vitæ, would seem to be even hardier than the type as it has succeeded on the prairies where the type or species did not. It is more compact than the latter, with characteristic bright green foliage. Many other varieties might be mentioned, none of which is as satisfactory as those just described. The golden-leaved sorts are more attractive when young than later.

Western arbor-vitæ or giant-cedar, *Thuja plicata*, is a very beautiful tree when growing wild in the mountains of western

Canada and at the Pacific Coast. While it is not often found there under cultivation, it makes a fine lawn tree, though requiring much room to develop to its full extent. When this species is obtained from the colder parts of its range, it does well at Ottawa, although a comparatively slow grower there. It is such an attractive tree that it should be tested more than it is.

The hemlocks.

The common hemlock, *Tsuga canadensis*, is one of the most beautiful North American trees. It is graceful in habit and its small foliage is of a distinct, characteristic, and pleasing shade of green. It grows to large size, but is a relatively slow grower, and for this reason makes a good lawn specimen for many years, as the branches usually are held to near the ground. One is fortunate in having large specimens of hemlock in a landscape where there are clumps of trees or woodland and it makes a very attractive feature. When used for hedge purposes, hemlock proves very satisfactory and makes one of the best low-growing evergreen hedges, as it is a slow grower and can be readily kept in shape. Moreover, it stands shade better than some other trees. Var. *gracilis* has smaller leaves than the type and is even slower growing. It is an ornamental variety. The common hemlock is not hardy on the prairies, but does well both in eastern Canada and in British Columbia.

Western hemlock, *Tsuga heterophylla*, makes a fine large tree in British Columbia, where it is native in the mountains and along the western coast. It is an important timber tree, the wood being better than *T. canadensis* in the East. While it has not been used much as an ornamental, it is attractive in appearance and very graceful in outline and should be planted more. It is not known under cultivation in eastern Canada,

From most sources it would prove too tender, but if obtained from the coldest districts where it grows wild it might succeed. This was long listed as *T. Mertensiana* in Canadian lists of plants.

Black hemlock, *Tsuga Mertensiana*, is a native of the mountainous and western coast regions of British Columbia. It is a rather small tree as it grows in Canada, with bluish-green foliage, and is quite ornamental, but has been little cultivated as yet. This may be grown successfully in eastern Canada if specimens are obtained from the coldest part of its range.

The junipers.

The junipers are not planted widely for ornament in Canada. Although some may not be particularly attractive, others make good lawn specimens and the low-growing sorts are very useful for covering banks or for rocky places. They are of comparatively little value for their wood in Canada, as none of them becomes more than a small tree and, except *Juniperus scopulorum*, are little more than shrubs at the best.

The savin, *Juniperus Sabina*, and its varieties, is the most generally useful juniper for ornamental planting in Canada. The vars. *cupressifolia* and *tamariscifolia* should be much more extensively employed where low-growing evergreens are desired. They are particularly effective when covering steep slopes or planted among rocks or in sandy places, where they look much at home. These varieties sometimes reach a height of three to four feet, but often grow close to the ground. They are dense in habit, very effective in a mass, and are quite hardy, doing well in the prairie provinces. The type has reached six feet in height at Ottawa.

The common juniper, *Juniperus communis*, has many varieties. The commonest one in Canada in most of, if not all,

the provinces is var. *depressa*, also sometimes called var. *nana*. It forms broad masses usually on stony or dry soil, and reaches a height of three to four feet. It is seldom planted for ornament, but it does much to improve the appearance of otherwise barren places. Var. *aurea* is a golden-leaved form of var. *depressa*, and is also hardy and rather attractive. The var. *montana*, sometimes called *alpina*, is found in the northern and mountainous parts of Canada. The most ornamental forms of the common juniper are var. *suecica* and var. *hibernica*. Neither of these is, however, quite satisfactory at Ottawa, as the tips of the previous year's growth are usually killed in winter and the branches are rather unsightly until new growth has been made. Both are very compact and upright growers, in fact, quite columnar. The Irish juniper has greener leaves than the Swedish. They do well in the coast region of British Columbia. The Swedish is, perhaps, a little hardier than the Irish.

Prostrate juniper, *Juniperus horizontalis*, has been confounded with *J. Sabina*. It grows wild in most of the provinces of Canada and usually lies close to the ground and trails over it, where it forms a virtual carpet. The foliage is bluish and when large masses are seen it has a very pleasing effect. It does well as a ground-cover in the prairie provinces.

The red-cedar, *Juniperus virginiana*, does well in eastern Canada as it is native there, but, owing to the dullness of the foliage, the type is not particularly valuable for ornamental planting. One of the best varieties is *elegantissima*, which is yellow-tipped, making a pleasing contrast in color. The habit is also more graceful than some. The var. *Schottii* has brighter green foliage than the type and is more attractive. Var. *glauca* has bluish foliage, which is quite distinct, but does not seem so hardy as the others. The pyramidal form is quite striking in outline, but the foliage is not very attractive.

Western red-cedar, *Juniperus scopulorum*, is native in the Rocky Mountains and through to the Pacific Coast. It is much like *J. virginiana*, but is a larger tree. It is not known in cultivation in eastern Canada.

The upright-growing forms of the Chinese juniper, *Juniperus chinensis*, have not proved sufficiently hardy in eastern Canada to be entirely satisfactory, except var. *mas*, which has done well. The low-growing varieties, such as *pendula* and *Pfitzeriana*, make very ornamental shrubs of compact habit, about four feet in height.

The specific name of the Japanese juniper, *Juniperus rigida*, would suggest a stiff habit. On the contrary, this is one of the most graceful junipers. At Ottawa, a specimen planted in 1896 is about twelve feet in height. The young branches are quite pendulous and the general habit of the tree pleasing. The foliage is of a yellowish-green, being quite distinct in color from most other species. This juniper is well worth planting as a lawn specimen.

The cypress.

The true cypress is too tender for Canada, but there are other trees known as cypress which are hardier. Few species succeed in eastern Canada, however, but on the lower mainland of British Columbia and on Vancouver Island they do well, the fine Lawson cypress being one of the most useful ornamental trees. The yellow cypress is the only species native to Canada.

Yellow cypress, *Chamæcyparis nootkatensis*, is a west coast species which is too tender in eastern Canada, although it and some of its varieties have grown for a time, but once above the snow-line they are killed back. Varieties with bluish foliage are quite attractive and when hardy are well worth growing.

There are many varieties of Lawson cypress, *Chamæcyparis Lawsoniana*, and most of them succeed well near the west coast of British Columbia where the winters are mild. In eastern Canada they are not hardy. Some of the best varieties are *Alumi*, *argentea*, *erecta glauca*, *erecta viridis*, *glauca*, *gracilis*, and *pyramidalis*.

White-cedar, *Chamæcyparis thyoides*, is hardy in eastern Canada and is interesting as being a native of the Eastern States. It is rather loose in habit with dull-colored foliage, and, on the whole, is not very ornamental, though interesting.

Hinoki cypress, *Chamæcyparis obtusa*, is a Japanese species which is fairly hardy at Ottawa if grown in a rather sheltered place, but needs a milder climate for best development. There are several good varieties which show to advantage in the coast region of British Columbia, among the best being var. *aurea*.

Sawara cypress, *Chamæcyparis pisifera*, proves fairly satisfactory in eastern Canada, being practically hardy. It is not as ornamental, however, as its varieties, which are referred to under retinispora.

The retinisporas.

The retinisporas are graceful Japanese conifers which are very useful for landscape effects in eastern Canada and in British Columbia near the coast. There is a marked difference, however, in the relative hardiness of the sorts, some of the varieties of *Retinispora pisifera* being the hardiest and most useful. They are really cypress of the genus Chamæcyparis.

Retinispora pisifera is hardy at Ottawa, but is not so ornamental as certain of its varieties. Among the best of these is var. *filifera*, which may be considered perfectly hardy at Ottawa, and, after a thirty-year test is still in excellent condi-

tion, the best specimens being about eighteen feet in height. The graceful, pendulous form of this tree and its linear leaves and branchlets make it a most attractive lawn specimen, and it cannot be too highly recommended. Some specimens are now developing more tree-like characters with a strong central leader.

The var. *plumosa* is a fine form, more compact in its habit of growth than the type. The leaves are bluish-green above and silvery on the under side. The tips of the branches often winter-kill at Ottawa and turn brown, rendering the specimen rather unsightly until the new growth is made. The golden-leaved form is not quite so hardy or satisfactory. This variety reverts to the type after fifteen or twenty years, branches appearing and taking the lead with foliage of *R. pisifera.*

Where var. *squarrosa* is hardy, as on the west coast, it is perhaps the most beautiful of the retinisporas because of its soft, light, bluish-green foliage. However, in eastern Canada it is the least satisfactory variety as it kills in patches in the winter, becoming very unsightly, although when somewhat protected by other trees it comes through fairly well.

Retinispora ericoides is sometimes *Thuja occidentalis* var. *ericoides*, and sometimes a chamæcyparis, but it is usually sold under the name of retinispora. It is of dwarf habit, with soft fine leaves and weak branches, and in winter is badly injured by snow at Ottawa, and usually there is more or less scalding of foliage. After the new growth is made, however, it is a pleasing object.

The yews.

Owing to the many persons of British origin living in Canada who have a certain reverence for the yew, of which there are such old specimens in Great Britain, there is considerable

PLATE XXI. Compact dwarf forms of arbor-vitæ (*Thuja occidentalis*). Tom Thumb at left; var. *Woodwardii* at right

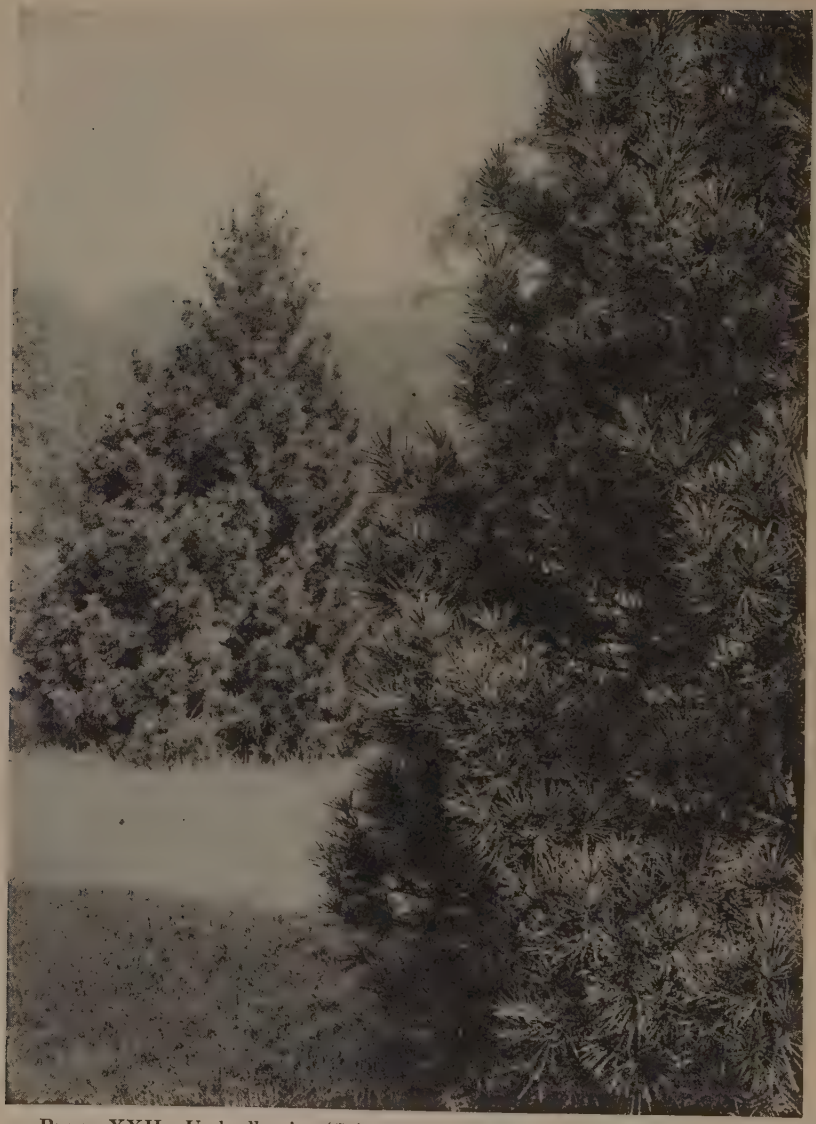


PLATE XXII. Umbrella-pine (*Sciadopitys verticillata*), near and remote views

interest in the yew in the Dominion. In the coast regions of British Columbia, where *Taxus brevifolia* becomes quite a fair-sized tree, one's affection for the yew is readily satisfied, but in eastern Canada the wild species, *T. canadensis*, is so unlike the British yew that it is scarcely taken into consideration. The Japanese yew, *T. cuspidata*, has filled the want there.

While the common yew, *Taxus baccata*, succeeds well near the west coast of British Columbia, it is not satisfactory in eastern Canada, although it will sometimes grow well for a time. No doubt, if plants were obtained from the coldest part of its range in Europe, the yew would succeed better than it usually does. A specimen of var. *variegata*, after twenty-three years' growth, is still in good condition at Ottawa and is now about five feet high.

The western yew, *Taxus brevifolia*, reaches a height of twenty to twenty-five feet or more along the west coast of British Columbia where it is native. It is not grown much under cultivation there, although it is a fairly ornamental tree. It is not hardy in eastern Canada above the snow-line.

Canadian yew, *Taxus canadensis*, is a native of Canada from the extreme east to the province of Manitoba. It has been under cultivation at Ottawa for thirty years and has reached a height of about five feet, but is so open in habit that it is not particularly ornamental.

The Japanese yew, *Taxus cuspidata*, has been under test at Ottawa for twenty-six years and has proved quite hardy. The best specimen, planted in 1896, is now about ten feet in height. The foliage is a rich deep green in color, and, as the tree or bush is of a compact habit, it is quite ornamental and makes a good substitute for *T. baccata*. The var. *nana* or *compacta* is also quite hardy, but specimens planted in 1896 are but three feet high, though compact in habit.

The cedars.

The three well-known species of cedar succeed near the Pacific Coast in British Columbia, namely, *Cedrus atlantica*, *C. Deodara*, and *C. libani*. The Deodar cedar is, perhaps, the most popular. They are striking-looking trees and are used with good effect.

The cryptomeria.

These beautiful Asiatic trees do not succeed in eastern Canada, but do well near the Pacific coast and especially on the southern part of Vancouver Island. There is but one species, *Cryptomeria japonica*, of which there are a number of horticultural varieties, the best being var. *elegans*. The attractive foliage and form of the cryptomerias make them very popular where they grow well.

The sequoias.

The sequoias, or big trees of California, of which there are two species, *Sequoia sempervirens* and *S. gigantea*, grow well near the southwest coast of British Columbia, including the southern part of Vancouver Island. The California big tree, *S. gigantea*, succeeds, perhaps, better than the other species, and is making a fine evergreen tree there.

CONIFEROUS EVERGREENS FOR THE MIDDLE WEST.—BOLLINGER

Pines are very easy to cultivate. So various are the soils and situations in which the different species are found in their native countries that there is scarcely a spot for which one or another variety is not suitable. Some grow on the bleakest hills and flourish in shallow sands near the Great Lakes and the seashores. For dry, windy and exposed situations, *Pinus ponderosa*, or bull pine, is well adapted. It thrives in pure clay,

and also does remarkably well in sandy soils. Its broad, coarse, twisted, flexible leaves of deep grayish-green, set firmly in a strong sheath, stand stormy, sweeping winds well. The tree may be used for screens, windbreaks, or as a background for other trees.

The red pine, *Pinus resinosa*, grows in almost any kind of land, except a heavy clay, but thrives best in a sandy soil. It is perfectly hardy, even in northern Canada, and is often planted in places where no other pine will grow. Its luxuriant dark green foliage and uniform size add to the landscape.

The gray pine, *Pinus Banksiana*, is found farther northward than any other American pine. It has no commercial value and is planted only on account of its peculiar stunted growth.

In America the Scotch pine, *Pinus sylvestris*, is cultivated largely for windbreaks and when quick growth is desired. It grows in most kinds of soil, from a heavy clay to a pure sand. This species bears transplanting better than other pines.

The white pine, *Pinus Strobus*, grows in very different situations and soil, except in pure sand or submerged, but thrives best in a sandy loam. It is extensively planted for forest purposes, not only in America but in Europe, on account of its fast growth and the commercial value of its wood, and is also widely used for ornamental planting on large estates for natural or for woodland effects. It is very pleasing as a background for other pines and conifers on account of its rapid, stately growth. White pines transplant easily and require less care after transplanting than any other pines.

The limber pine, *Pinus flexilis*, resembles somewhat the white pine, but is of more compact habit and the foliage is a darker green. It is perfectly hardy in the Northwest and grows in any kind of soil, but prefers a sandy loam. The branches are flexible and the tree of bushy habit. It is used in ornamental

planting for barren bluffs and ravines where natural effects are desired.

Pinus nigra var. *austriaca*, or Austrian pine, is grown for its wood and for ornamental purposes. Its form is a regular symmetrical pyramid, and when older its flat top becomes picturesque. It is valuable for bold natural effects and windbreaks. Given ample space it will maintain its lower branches and become a source of beauty for thirty to forty years. Its dark green foliage and stiff branches will withstand wind and heavy snow.

Pinus Mugo is one of the best of the pine family for low and compact growth. In form it varies from a prostrate shrub to a pyramidal tree twenty-five to forty feet in height. This pine is perfectly hardy in any part of the United States and Canada and grows in any kind of soil except in low muck and undrained marsh-land; it will do well even in sandy, gravelly soil.

Pinus rigida, or pitch pine, is an open, irregular, pyramidal tree to about seventy-five to eighty feet high. It is planted on rocky slopes on account of its picturesque habit when older. Plants are easily raised from seeds.

Pinus pungens, western table mountain pine, is a most interesting irregular tree and when young resembles *P. Mugo* in habit but not in color. Its foliage is of a pale yellowish-green. This tree will grow thirty to forty feet high. The branches are spreading, forming a broad often flat-topped head. It is hardy in the Northwest and Canada. The tree grows in moist soil but prefers a gravelly subsoil.

The Swiss stone pine, *Pinus Cembra*, has been a favorite for ornamental planting. Its leaves are dark green and the tree of very compact pyramidal form. The branches are short and when the tree is older it becomes often very picturesque,

having an open round-topped head. It is somewhat difficult to raise from seed as they are slow to germinate and the seedlings are likely to damp off unless closely watched on hot, sultry days.

Pinus densiflora is perfectly hardy, of compact habit, but exceedingly slow in growth. Its density of foliage and drooping habit make it a valuable ornamental tree for formal effect. The foliage is a bright green. The var. *globosa* forms a perfectly flat top. It is quite hardy and valuable for ornamental planting, and is a promising asset to the newly introduced conifers.

The spruces are natives of the cold climates and should not be planted extensively in the South. In northern Illinois and southern Wisconsin the white, black, blue, and green Colorado spruces are very often badly damaged by the red-spider. When a good force of water is convenient, they are easily eradicated; if not, the trees will gradually die. Like the pine, spruces are easily propagated from seeds sown in the spring.

The white spruce, *Picea glauca*, is perfectly hardy in the extreme North. It grows in any kind of soil and can stand low situations better than any other spruce. Its height is about fifty to sixty feet. The trees are planted very extensively for ornamental purposes on account of the pleasing whitish-green color.

Black spruce, *Picea mariana*, grows in nearly the same situations as the white spruce. Its habit is a regular pyramid, its foliage bluish-green, and the bark lighter colored. The wood is inferior in quality and snaps frequently in burning. It is a beautiful tree while young and is valuable for parks and gardens on account of its close, compact growth, color of foliage, and the retaining of its branches close to the ground even when old.

The Norway spruce, *Picea Abies*, is probably the best known

and most extensively cultivated spruce in the United States and Europe. It has a straight trunk from one hundred to one hundred and fifty feet in height and from five to six feet in diameter. None is better adapted for planting in narrow strips for shelter or seclusion, because of its rapid growth; it makes excellent hedges for shelter in nursery-gardens, windbreaks for fruit-gardens and farm buildings. In the great prairie country of America this beautiful and useful tree should be planted for protection. It grows in any kind of soil except gravelly and sour or water-soaked, undrained ground. It maintains its branches well to the ground if given ample room to grow, and is, therefore, valuable for single specimens on lawns as well as for a background to other evergreens. The foliage is dark green, and when older the branches are drooping, melancholy yet graceful, and beautiful for the open stretch of landscape as well as for woodland effects.

Some of the variegated forms of Norway spruce are interesting when young. The young growth of var. *argenteo-spica* is whitish, gradually turning a pale green. Var. *aurea* has leaves of a golden-yellow on the exposed side and the remainder dark green, giving the tree a peculiar aspect. Both varieties are beautiful when the sun plays on the branches, which on young trees are erect, but when older become pendulous. Trees do not grow quite so fast as the Norway spruce, but are just as hardy, and grow well in any kind of soil, even in a heavy clay. They do especially well in partially shady places and in the open lawn; on account of the dense growth are well adapted for single specimens. These forms should be grafted on the Norway spruce when dormant, as they do not come true from seed like most variegated conifers.

Picea pungens, Colorado spruce, grows in all soils, seems perfectly hardy in most northern climates and is easily raised

from seeds. It is a strong, symmetrical, upright tree. The color of foliage varies from light silvery to dull green, and from a dark blue to light purple. Color and form make it a valuable tree for the landscape-gardener. It is of very slow growth until about a foot high, then it seems to shoot up very fast, keeping its lower branches well to the ground. This spruce is not so easily transplanted as some other piceas. It should be root-pruned or transplanted at intervals. It develops fibrous roots. Transplanting on cloudy days and a liberal overhead watering for several consecutive days will benefit the plants. The red-spider is a common enemy of this beautiful spruce. A good force of water applied once or twice a week during the growing season will usually prevent this pest.

Picea Engelmanni somewhat resembles the white spruce, only it is more beautiful in color and texture of foliage, a silvery-bluish hue. The habit of the tree resembles *P. pungens*. It is just as valuable for ornamental planting, but should be placed on northern exposures. It is unable to stand the hot, dry winds in the open prairies, but is perfectly hardy in the other Northern and Western States. The tree grows well in a clay loam, but not in a gravelly or sandy soil.

Another interesting spruce is *Picea orientalis*, native of Asia. It does well only in partially shaded situations and it does not grow rapidly. It holds its branches well to the ground and thrives best in a rich black loam. This species is subject to winter sunburn, and should be planted on northern exposures or where it is partially shaded during the winter months by other trees.

The hemlock spruce, *Tsuga canadensis*, likes moist ground and will grow to a height of seventy-five to eighty feet, with a circumference of six to nine feet, and uniform for two-thirds of its length. When young and planted in a favorable soil, the

hemlock is very ornamental, owing to the symmetrical arrangement of its branches and to its tufted foliage. At this age it is used for hedges, owing to its density of growth and ease of shearing. It is very valuable for single specimens and if pruned occasionally will maintain its branches well to the ground. If planted with erect-growing conifers the hemlock will relieve their stiff effect with its graceful drooping branches. It will adapt itself well in shady places for undergrowth for other trees and will grow in such situations better than any other evergreen. For planting on northern exposures of bluffs and ravines, the hemlock is most valuable.

Abies balsamea, balsam fir, rarely exceeds fifty feet in height. As an ornamental it has no special value, as it retains its beauty only for the first fifteen years. During this period, when in health and vigor, it is extremely beautiful, both in color and form. Balsam fir should be employed in ornamental planting rather as a filler and not as a permanent tree for later years, as it loses its lower branches, has a sickly appearance, and should then be removed. The balsam fir is easily propagated from seed, which germinates freely.

Abies concolor, white fir, is grown extensively for ornamental purposes. It is perfectly hardy in all parts of the United States. It grows in any kind of soil, but thrives best in a well-drained clay or loam with a gravelly subsoil; it will not do well in low or water-soaked, undrained ground. The color of the foliage varies from a soft sea-green to a deep blue. Its stately, erect, and spreading branches give this tree a strikingly noble character. The white fir withstands heat and drought well in the Middle West. It grows from one hundred fifty to two hundred fifty feet high and its trunk from three to six feet in diameter. The seeds taken from the Colorado type are more likely to germinate than those grown at the Pacific Coast.

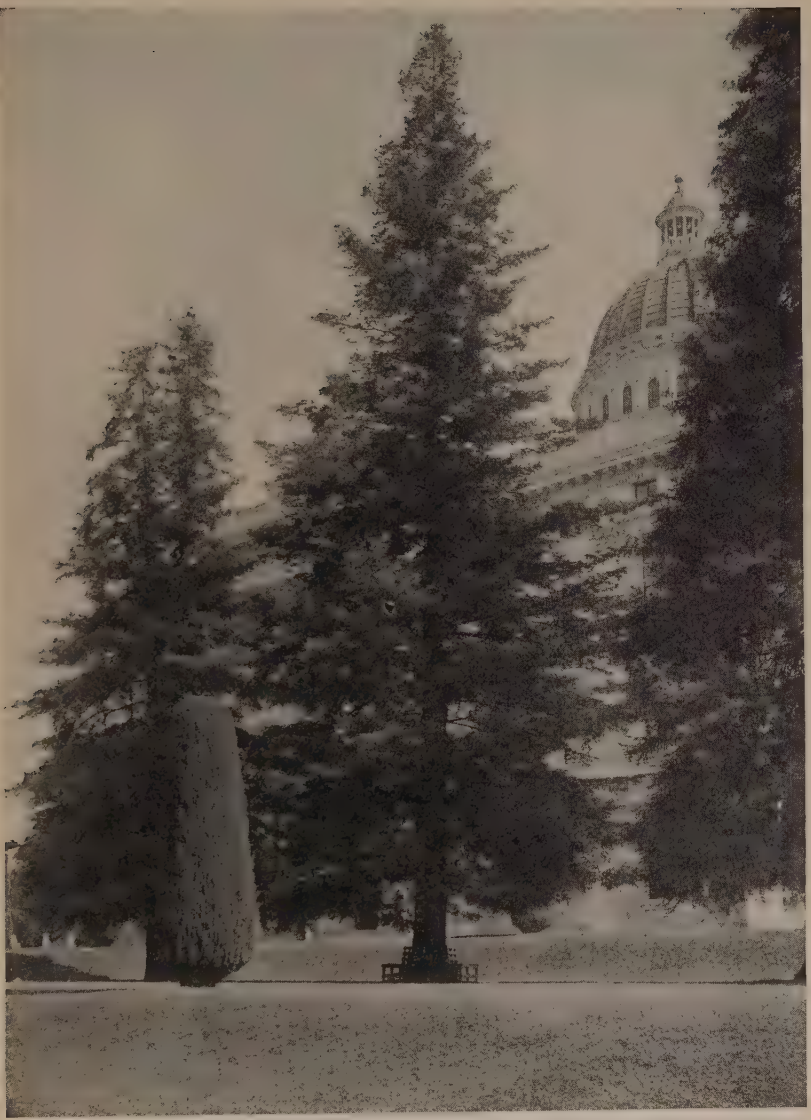


PLATE XXIII. A California planting.—*Sequoia sempervirens* in center; Italian cypress (*Cupressus sempervirens* var. *stricta*) clipped into formal shape for about thirty years

PLATE XXIV. Spreading cryptomeria (*Cryptomeria japonica* var. *elegans*)

The Nordmann fir, with its dark green foliage, silvery-white below, does well when planted with other evergreens in groups, when it is partially if not wholly shaded and protected from the winter's sun. Most firs are subject to sun-scorch, but especially *Abies Nordmanniana* and *A. Veitchii*. Both are perfectly hardy and should be planted on a northern exposure, in medium clay loam. They will do well on undrained land or in a gravelly hard-pan soil.

Pseudotsuga taxifolia, Douglas fir, is valuable for landscape planting on account of its easy propagation from seeds, easy transplanting and fast growth, hardiness and adaptation to any soil except low, undrained, swampy soil. The tree is of tall symmetrical habit. The foliage varies in color from a dark green to a light bluish-silvery hue. It withstands the wind remarkably well and can stand considerable shade, maintaining its branches to the ground when given ample room, and making fine lawn specimens.

Thuja occidentalis, or white-cedar, is one of the hardiest and best evergreens for shelter-belts and timber planting. The American arbor-vitæ is the original from which many types have been developed. When planted with ample space, it maintains its branches from the bottom up. It is, therefore, very attractive for lawns and windbreaks. This tree is very hardy and dependable in almost any situation, but moist location is preferred. The foliage is soft and flexible and of fine deep green color. The tree is easily grown from seeds sown in early spring in lath frames or brush-shades. Var. *Douglasii aurea* is a type with deep yellow foliage, of medium height, forming a broad bushy specimen. In planting it is grouped with other evergreens and adds contrast with its unusual bright golden color, being especially attractive when planted with the darker shades of green as a background. It grows in any

ordinary good soil, but does especially well in a damp, cool, clay loam. It does not always come true from seed and is usually propagated from cuttings taken in early fall, with gentle bottom heat in frames or greenhouse. The cuttings should be kept cool until callousing takes place, when heat both in bottom and top can gradually be increased. Cuttings should be shaded from the direct sun, watered freely overhead, and given plenty of air. Var. *Douglasii pyramidalis* has feathery, lace-like, crested foliage of a dark green color. The habit is pyramidal. It is of slow growth, to about eighteen to twenty feet high, and is perfectly hardy and grows well in moist clay loam. Var. *lutea*, Peabody golden arbor-vitæ, is a distinct bright golden type. It is of rather slender growth, twelve to fifteen feet high. It grows best in clay loam. On account of its brilliant golden hue, it is useful where color effect is desired. Var. *alba* has silvery white-tipped foliage, forming a pleasing contrast to the otherwise dark green leaves. It varies in habit from a low compact growth to a loose, feathery, pyramidal bush, and is hardy and easily propagated from cuttings or by grafting. Var. *robusta*, Siberian arbor-vitæ, is a very beautiful, dark green, conical type. Its habit is distinct and its branches short and stiff. The foliage is a dark sea-green. It is of rugged constitution and perfectly hardy, but of slow growth. It is propagated from cuttings. Var. *Woodwardii* is one of the best globe-shaped arbor-vitæs. It maintains its shape without artificial means. The color of foliage is a pleasing sea-green. It grows about three feet high and is as hardy as the species. Var. *Hoveyi* is a very pretty, dwarf, compact form, with yellowish-green foliage. The habit is globose. It is hardy in southern Wisconsin, Minnesota, and other western States and is useful for low planting in front of other taller-growing plants. It is propagated from cuttings. The soil requirement is a moist

well-drained silt loam, but it also does well in moist, black, mucky soil. This plant is subject to winter sun-scorch and should be planted where the rays of the sun will not fully reach it in the middle of the day. Var. *Smithiana* is a beautiful, low-growing, compact form. The very dark green, soft foliage, gradually changing to almost purple in the fall, gives this plant a special merit where low growth in formal and rock-gardens is required, also for grouping in front of taller varieties. It will maintain its low-growing tendencies, but will spread, unlike any other arbor-vitæ. It grows best in a well-drained clay loam and is easily propagated from cuttings, the wood being rather soft. It is perfectly hardy and does well in partial shade as well as in the full sun. It is not subject to sunburn in late winter, and is easily transplanted. Var. Tom Thumb is the smallest of its class known, being a tufted little plant of very low, compact growth, rarely exceeding nine inches. It is valuable for rock and Japanese gardens and the edgings of walks. The plant is propagated from cuttings and is perfectly hardy in the Northwest.

Chamæcyparis, or *Retinispora*, *pisifera*, is an open grower of upright form, the branches somewhat pendulous toward the end. The foliage is light green, glaucous beneath, very graceful and feathery. Var. *filifera* is a medium-sized pyramidal tree of unusually graceful outlines, the ends of the branches drooping in long filaments. This variety seems to be perfectly hardy in the most extreme exposures, either to heat or cold. It does best when planted in a damp but well-drained clay loam. Var. *plumosa* (Chamæcyparis) and its variants are not hardy in the extreme North, but in the Middle West they are planted extensively on account of the beautiful soft foliage and pleasing form. These are perfectly hardy without protection even in the northern parts of America. Both varieties are propagated

from cuttings and grafting. They require a silt loam soil with perfect drainage.

Retinispora plumosa argentea has light green foliage and white-tipped branches. *R. plumosa aurea* is a golden form. Both varieties require some protection in winter, especially from the sun. *R. squarrosa* is a densely branched bushy tree with spreading feathery branchlets. It is not a strong grower and should be planted in front of taller trees. All the retinisporas are propagated from cuttings or grafted. They require care when young, gentle bottom heat for the cuttings in lath frames as well as in the greenhouse, and copious watering overhead.

Chamæcyparis, or *Retinispora, obtusa*, is a bushy grower of solid or compact form. It is one of the strongest growers of its class. The foliage is firm, of a clear green color and graceful drooping habit. Var. *nana*, with very dense, short foliage of an extremely dark green, is well adapted for rock-garden planting.

Taxus canadensis, American yew, is a valuable dwarf evergreen seldom more than three feet high, with dense, dark green foliage. It is particularly attractive in autumn when loaded with its scarlet fruits. It thrives best in shady situations and well-drained silt loam and is hardy in the Northwest and Canada. This yew is useful for nature planting as well as for hedges and formal gardens. It can be pruned to any desired shape. The foliage assumes a reddish tint in winter. It is propagated from cuttings in lath frames with gentle bottom heat or in hothouses.

Taxus cuspidata, or Japanese yew, grows forty to fifty feet high in Japan, but under cultivation does not attain this height. It is one of the hardiest yews and withstands extreme heat and cold in America. It is of close, upright, compact

habit. This beautiful yew is valuable on account of its dark, luxurious foliage and irregular form of growth. The tree grows in any rich garden soil with perfect drainage. It is propagated from cuttings and grafting on *T. canadensis.*

Taxus brevifolia is of dwarf, compact growth. It is the darkest of all evergreen trees and is of irregular and picturesque outline, about five to six feet high and with a spread of four to five feet. It is very popular on account of its extreme hardiness and beautiful dark green color. It requires a rich clay loam and perfect drainage and is propagated from cuttings and by grafting on *T. canadensis.*

Taxus baccata var. *repandens* is a low spreading form with luxuriant dark green foliage not unlike *T. cuspidata,* but of lower growth and more spreading. For planting in front of other evergreens it is one of the most desirable. It stands the winter well when planted in a sandy loam with perfect drainage. It is well to shade the plant somewhat when exposed to full sun in late winter as it is somewhat subject to sunburn, and, therefore, does best on a northern exposure. Var. *aurea* is a golden form. Var. *fastigata* and *fastigiata aurea* can be grown in the Northwest with protection and planted in a protected spot among other evergreens. All varieties of English yew are propagated from cuttings or grafting.

Of late years the red-cedar (*Juniperus virginiana*) has been extensively employed for ornamental planting, especially in the Northwest and Canada. Its extreme hardiness and stately, upright, compact habit make it very useful for windbreaks, especially for exposed, windy positions. It grows well in any soil except in a sour alkali, but does best on a gravelly or sandy subsoil. The color of foliage varies from a dark green to a steel-blue. Junipers vary in habit from a tall pyramidal tree to a low prostrate or trailing shrub. *J. virginiana* and its

allies are mostly propagated from seeds, cuttings, and layers. The seed is hard to sprout and requires two to three years for germination. When propagated from cuttings, a gentle bottom heat is required. It is best done under glass, taking the cutting from nearly ripened wood in the early fall. Stool cuttings are preferable for those varieties with scale-like leaves. These are also increased by side grafting in the winter on previously potted plants of allied species. Copious watering overhead is essential until the graft is set. The plants propagated by layers in early fall require gentle bottom heat.

Juniperus virginiana var. *glauca* is a distinct blue type of pyramidal habit. The young growth is almost silvery-white, changing to a beautiful bluish-green in winter. For landscape effect it is excellent. It is perfectly hardy, of compact growth, and thrives in a rich clay loam. Propagation is by grafting on *J. virginiana.* Var. *Schottii* is planted for its pyramidal, compact growth and extreme hardiness. It is propagated from cuttings. Var. *Canaertii* is a pyramidal compact form attaining a height of fifteen to eighteen feet. The foliage is dark green. The plant is useful for planting in formal and natural gardens and its silver-colored fruit is attractive. It does well in any ordinary garden soil and is propagated from cuttings and grafting.

Juniperus communis var. *depressa* has many branches and seldom exceeds five feet in height. It thrives best in a sandy or gravelly soil and is extremely hardy and a rapid, vigorous grower. The foliage is grayish-green, light silvery-green beneath. It is propagated from seeds and cuttings. Landscape planters make use of it to cover unsightly spots and as an edging to taller trees. Fruit of this variety matures the third year when it is used for medicinal purposes and manufacturing of spirits. Var. *aurea* is a golden form. It is hardy and useful for color effect with other junipers.

Irish juniper, var. *hibernica*, is a compact, pyramidal or columnar form. It does best in damp but perfectly drained soil and is quite hardy in the Middle West. It requires copious and frequent watering during the summer months. It is valuable for formal planting in gardens and lawns. Propagation is by cutting or grafting. Swedish juniper, var. *suecica*, is quite similar to var. *hibernica*, but grows higher and is of a lighter and more bluish color and the branches do not grow quite as stiff and compactly. In general the form is pleasing and useful where formal effects are desired. It is propagated from seeds, cuttings, and grafting.

Juniperus horizontalis is a trailing or creeping form employed for ground-cover and edging garden walks. It is propagated from cuttings and layers. The Waukegan juniper, var. *Douglasii*, is an interesting creeping form. It seems to love the sand and gravelly soil, yet it will do equally well in rich garden soil or on rocky slopes, banks, and terraces. The color of the foliage is a soft blue in spring, changing to a rich purple color in the fall. This form is very useful for wall-covering, rock-gardens, and edging of walks. It is a rapid grower and easily propagated from layers taken in early October and planted in lath frames in a sharp sand. The plant thrives on sunny slopes and does equally well in partially shady situations.

Juniperus scopulorum is a narrow, compact, symmetrical form with one single stem. It grows well in the North and South. It is valuable for landscape effect on account of its close, compact and erect habit and beautiful silver foliage. Propagation is by cutting or grafting on allied stock.

Juniperus Sabina is very hardy, of erect habit, with numerous spreading branches. It is useful for a foundation for other trees. The plant does best in a dry, gravelly, sunny situation.

Propagation is from layers and cuttings. Var. *tamariscifolia* is an excellent dwarf creeping variety, suitable for rock-gardens, edging, and ground-cover. It is quite hardy in the Northwest and is one of the best of the low type of junipers.

Juniperus chinensis var. *albo-variegata* is a white-tipped form of columnar growth, reaching a height of twenty feet or more. The foliage is a dark bluish-green with white tips at the end of twigs and branches. It requires a damp but well-drained soil and is useful for planting in formal gardens and lawns. Var. *aureo-globosa* forms a perfectly round globe, is very dense in growth, with light green foliage having a yellowish hue. It is valuable where low planting is desired in rock-gardens, Japanese and flower-gardens. It requires a rich sandy loam, is propagated from cuttings and grafting on allied stock and is quite hardy if planted on well-drained soil. Var. *japonica* is a very dwarf form seldom growing over twelve inches high. It is a rapid grower, producing long branches that cling to the ground. It is useful for terraces, hillsides, and edging of rock-gardens and is perfectly hardy. Propagation is by cuttings and layers. Var. *Pfitzeriana* forms a low, broad pyramid. The branches grow horizontally from the stem, forming a flat, spreading top. It is not a rapid grower, attaining a height of six to ten feet, and is perfectly hardy. This variety is valued for its graceful plumosa-like foliage. Propagation is by cuttings and grafting.

CONIFERS FOR THE PACIFIC SLOPE.—Braunton

Conifers should be planted only for certain restricted uses for which they are peculiarly well fitted. Indeed, so many conifers do not thrive luxuriantly in the semi-arid atmosphere of California that they are not always ornate. Those from humid climes are poorly clothed, and this deficiency becomes

PLATE XXV. Nikko fir (*Abies homolepis*)

PLATE XXVI. Good young plant of Algerian fir (*Abies numidica*)

more marked with age, so that many species are welcomed in youth, tolerated at mid-age, and destroyed when old. In fact, in southern California conifers of large size are not easy to find, yet many were planted long years ago. Their retirement from public favor may be due, in part, to their misuse in landscape planting. It is not uncommon to see conifers native to snow-capped mountains on the lower levels, and above, other and broad-leaved evergreens from the tropics—evergreens so tender that their foliage is injured by light frosts. It is rarely indeed that conifers may be planted harmoniously below the line of ordinary vision. Conifers are primarily for the heights and should overtop all other trees. They should not be too closely associated with dwellings, unless on tracts of some altitude or as backgrounds above to relieve otherwise bare landscapes and provide or suggest shelter.

Parks and large gardens may carry conifers in considerable numbers, but the small garden is better with none, or the planting confined to dwarf species or one or two isolated specimens of unusual attractiveness. Considerable space is needed for natural development without pruning, and seldom does a conifer attract favorable notice or comment when the lower branches have been removed. For this reason, conifers are unfitted to roadside alignment unless a parking of twenty or more feet has been reserved. The greatest misuse to which they are subjected in California, and the most common, is to mix species from habitats of almost perpetual snow with palms from the tropics, several of each on an ordinary city lot. Aside from contrasts in form, the palms are in shades of lightest green, while the conifers are of the darkest.

California possesses numerous native species of conifers. Including Taxaceæ, they number forty-two, divided in popular groups as follows: Pine family, twenty-eight; redwood family,

two; cypress family, ten; yew family, two. So many of these are of decided horticultural value that one may plant richly and in great variety of species and general appearance without using other than natives of California. While all pines are much alike in general appearance, and also cypresses, three species of the latter family have unusually handsome and distinct foliage and are widely planted in park and garden. They are: *Libocedrus decurrens*, incense-cedar; *Thuja plicata*, canoe-cedar; and *Chamæcyparis Lawsoniana*, Port Orford cedar, better known in California as Lawson cypress. However, of all native conifers planted as single or solitary specimens, the most popular are the redwoods, or, as known to the plant trade, the redwood and the big tree, *Sequoia sempervirens* and *S. gigantea*.

Of the twenty-eight species of native pines, several are employed in forestry work by the state and federal departments and only about four in ornamental grounds. Of the latter, *Pinus radiata* is used more than all species combined, either as an ornamental or for woodlot and small forest plantings. It is, however, very short-lived, being estimated that at the most it lives but one hundred fifty years, and on its native heath it sometimes dies at forty years of age. In park and garden it does not always live the stated minimum, so that many perish of mature old age during the life of the planter. The three other garden species, in the order of their popularity, are: *P. Coulteri*, *P. Torreyana*, and *P. cembroides* var. *Parryana*, the latter often catalogued as *P. quadrifolia*.

Of cypresses, the Monterey, *Cupressus macrocarpa*, far outclasses all other species in numbers planted. Thirty years ago it was much used for hedges in city and village, but hedges are now very little planted, though Monterey cypress is much in evidence in windbreaks about orchards and is almost the only

conifer so employed. Of the yews, the one known as the California-nutmeg, *Torreya californica*, is more planted than the western yew, *Taxus brevifolia*, though neither is much used in gardens. It is well known that coniferous trees seldom sprout from the stump when cut down, but these yews do. In this respect the nutmeg is extremely vigorous, as much as the redwood which is noted among conifers for stump-sprouting and the rapid growth and great size of comparatively young second-growth trees. In odd forms and habits California has but one curiosity, a weeping spruce, *Picea Breweriana*, a very pendulous form.

Cedrus Deodara is by far the best conifer for general planting in all parts of the Pacific Slope. *C. atlantica* var. *glauca* may be given second place. *Araucaria Bidwillii*, *Sequoia sempervirens*, *Chamæcyparis Lawsoniana* and its varieties, *Libocedrus decurrens*, *Araucaria excelsa* and var. *compacta*, *Cupressus guadalupensis* and var. *glauca*, *Abies Pinsapo* var. *glauca*, *Picea pungens* var. *glauca*, and *Cupressus arizonica*, are most frequently planted in the order named. In the region of Los Angeles *Taxus baccata*, *Taxodium mucronatum*, and *Agathis robusta* thrive.

In northern California the following are the most satisfactory conifers: *Abies balsamea*, *A. Nordmanniana*, *Cedrus atlantica*, *C. Deodara*, and *C. libani*, *Chamæcyparis Lawsoniana*, *Cupressus arizonica*, *Juniperus communis* var. *hibernica*, *Libocedrus decurrens*, *Picea Abies*, *Pinus radiata* and *P. excelsa*, *Sequoia sempervirens* and *S. gigantea*, *Taxus baccata* var. *fastigiata*, and *Thuja orientalis* var. *aurea*.

For southern California the most popular conifers planted are: *Libocedrus decurrens*, *Cedrus Deodara*, *Pinus canariensis*, *Picea Abies*, *Cupressus guadalupensis* and var. *glauca*, *Chamæcyparis Lawsoniana* and varieties, and *C. obtusa*, *Cupres-*

sus arizonica, *Abies Pinsapo* and *A. concolor*, *Picea pungens* var. *Kosteriana*. Other species worthy of mention are: *Cryptomeria japonica* var. *elegans*, *Thuja orientalis* var. *aurea*, *Cupressus sempervirens* and *C. macrocarpa*, *Pinus radiata*, and *Juniperus chinensis*.

In the cold snaps of January, in the years 1913 and 1922, many of the largest and oldest *Araucaria excelsa* were frozen to death and size and age seemed to be no protection, as it is generally conceded to be with trees in general. Some of the very largest in Los Angeles perished, and they seemed to be frozen in all parts, from the base of trunk covered with thick bark, up to the tip, seventy-five or more feet above. This freezing of mature bark-protected trunks is believed to be due to continuation of low temperatures through several nights, which was cumulative in effect, gradually breaking down the tissues. Lower temperatures of shorter duration would not have resulted in such fatalities, which, strange to say, were not visited upon any other conifer.

The remarkable ease with which the Monterey pine and the Monterey cypress may be grown from seeds and safely transplanted, coupled with their drought-resistance, have made them prime favorites for covering bare hillsides when landscape effect is sought. When fuel is desired, eucalypts are planted. California, except in very cool and damp coastal districts, is too hot and dry during summer to suit some very ornate species. *Araucaria brasiliana* and *Cunninghamia lanceolata* are two of this class. Unless planted in a lawn, where there is a constantly rising humidity, *Araucaria araucana* grows but slowly and is poorly furnished with branches near the ground. In Golden Gate Park, San Francisco, it reaches a better development than at any point farther south. *Cedrus Deodara* has proved a pleasant surprise in its really remarkable adapta-

bility to a great variety of soils and climates, even on the dry hillsides of forest reserves in the south end of the State. Another handsome conifer also growing well in similar situations is *Pinus canariensis*. Single conifers are seldom planted primarily for shade, but *P. Pinea* has received such consideration and may occasionally be seen in garden or farmyard, singly or in groups of three or more. It is the only round-topped or umbrella-shaped conifer.

A few species are planted because of the oddity or beauty of the leaves, such as *Agathis robusta*, the Dammar-pine from Australia. Its thick flat leaves are two inches wide and three inches long. Species of Podocarpus are also provided with leaves similar to those of the blackwood, *Acacia melanoxylon*. More nearly needle-like, yet somewhat "leafy," is the foliage of *Sciadopitys verticillata*, the Japanese umbrella-pine, a species not common on the south Pacific Coast, but more popular northward in more humid atmospheres. All conifers on the Pacific Slope thrive better the farther northward they are planted, except those requiring subtropical winter temperatures. So favorable are the climates of Oregon and Washington to the growth of conifers that the planter need consider but the one point of hardiness to cold.

CHAPTER IV

THE INSECTS, DISEASES, AND INJURIES OF ORNAMENTAL CONIFERS

A CONNECTED discussion of the insects, diseases, and main injuries to which ornamental conifers are subject, is here brought together in this country for the first time. With the exception of the white pine blister-rust (page 154), none of these pests is likely to be greatly destructive over large areas, although the white pine weevil (page 127) is a serious menace and a more adhesive paint-like spray is apparently needed for it. The grower of conifers, however, must always be on the lookout for insect and pathological depredations; and those that seem to differ from the ones here described or which are doing extensive damage should be promptly reported (with specimens) to the experiment station of the State or to the United States Department of Agriculture.

This chapter is in two main parts—the insects (page 124), and the diseases and injuries (page 138). These parts are prepared by specialists directly for this book, the former by C. R. Crosby, Extension Professor of Entomology, and J. B. Palmer, Instructor, Cornell University, the latter by F. Dickson, Instructor in Plant Pathology, Cornell University.

The second part, on diseases and injuries, is divided into four coordinate parts:

1. Coniferous seedling diseases and injuries, page 140.
2. Diseases and injuries of older coniferous trees, page 144.
3. Tree surgery, page 161.
4. Fungicides, page 165.

Experience of growers with insects and diseases in this class of plants should be assembled and organized. On the subject of the spraying of conifers, George P. Brett writes as follows:

"It is desirable that more experiments in regard to the spraying of evergreens should be made, as there is little satisfactory information to be had about it at the present time from the standpoint of the ordinary amateur grower. What is the best spray for the pine weevil, for example, and is there any spray that will check the depredations of pine blister-rust? As far as the pine weevil is concerned, I have tried arsenate of lead, scalecide, and some other preparations, but not with complete success. What is wanted for this veritable scourge of the soft-needle pines is, I should guess, a sort of paint which would prevent the attack, this paint to be applied to the leading shoots at the time of the year when the danger exists, and it ought, with proper experiments, it seems to me, to be easy to find some deterrent which would keep off the attacks of the insect without poisoning the tree.

"The imported sawfly is easy to manage if you attend to it in time. It mostly attacks the soft-needle pines, and I have seen Cembra, Banksiana, Strobus, and the Bhotan so completely stripped of their needles by the larvæ of this fly as to kill the tree, but it can be easily controlled with arsenate of lead, provided care is taken to make the applications frequently enough to care for the broods which appear at regular intervals during the summer, the last brood on my place this year, for instance, having appeared in late September, just before we had our first serious frost. The Scotch pine and the hemlock are also attacked by this pest, but little damage seems to be done to these trees, the larvæ apparently thriving only on the soft-needle pines."

INSECTS OF CONIFEROUS EVERGREENS.—Crosby and Palmer

The number of insects doing serious damage to conifers under conditions of cultivation is relatively few, and the discussion of the depredations need not be extensive. This account begins with insects more or less common to all conifers —the borers and bark-beetles, the bag-worm, and the gipsy moth. Then follow the insects preying specially on pines, spruces, and larches.

Borers and bark-beetles.

Conifers that are in a weakened or unhealthy condition from insect depredations or other causes are subject to attack by a host of borers and bark-beetles of many kinds. The borers may burrow just under the bark or in the solid wood, often causing decay to ensue. Bark-beetles bore through the bark and construct brood chambers between the bark and the wood in which they deposit their eggs. The larvæ or grubs form burrows which gradually increase in size as they become larger. These burrows are half in the wood and half in the inner bark. When abundant they girdle the tree or branch, causing its death. When the bark is removed, their burrows are evident in impressed grooves in the surface of the sapwood. These engraved patterns are characteristic of the species and have given the insects the popular name of "engraver beetles."

The depredations of borer and bark-beetles can only be prevented by keeping the trees in a healthy and vigorous condition, since most of these pests are unable to gain entrance or breed in thrifty trees. After the tree has been weakened so that the infestation has begun, there is little that can be done to prevent its death.

The bag-worm (*Thyridopteryx ephemeræformis*, Haworth).

Arbor-vitæ and cedar in southeastern New York, central

PLATE XXVII. Cilician fir (*Abies cilicica*). Two views

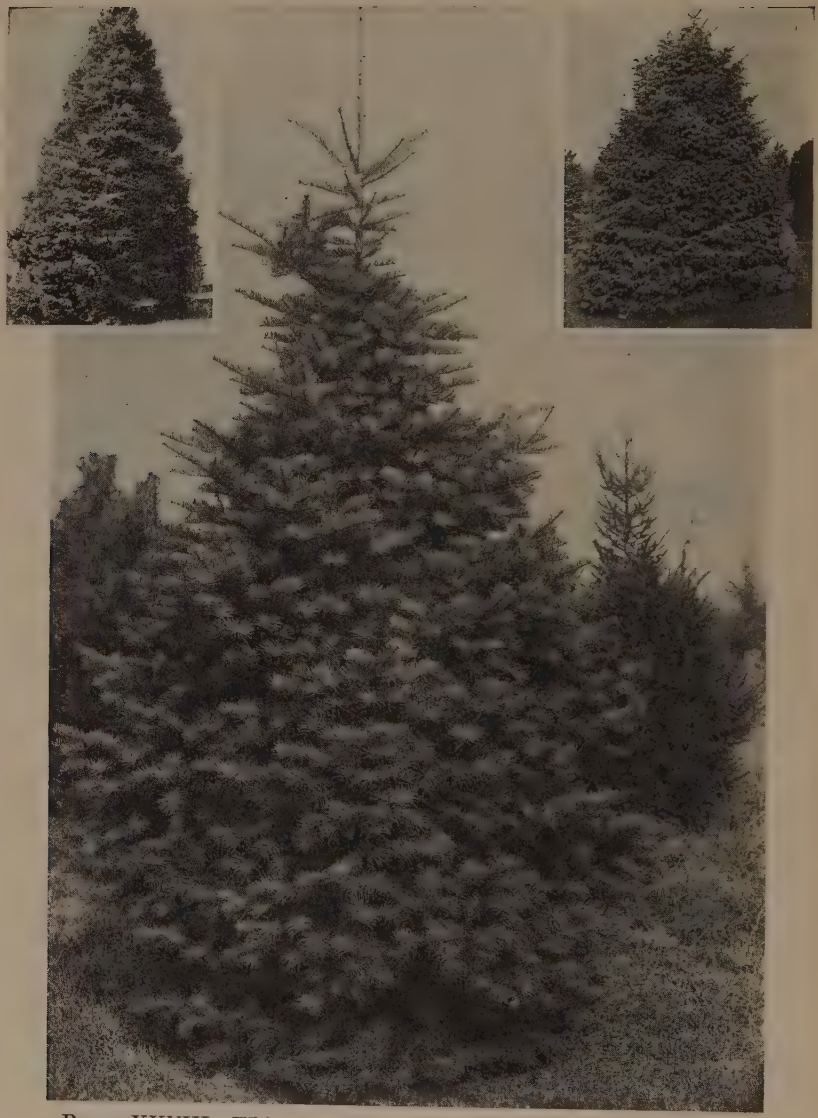


PLATE XXVIII. White fir (*Abies concolor*). Young tree in foreground; much older specimen in upper left corner; dense tree in upper right, the result of removing the buds from the terminal growths some years before.

Ohio, and southward are subject to attack by the larva of a moth which protects itself by a silken bag into which are incorporated bits of leaves and small twigs. The larva remains in this bag throughout its entire feeding period and carries the bag with it wherever it goes. It protrudes the head and front part of the body when moving about or feeding. The young larvæ appear in May or June and maturity is reached in the fall. The female moth is wingless and does not leave the bag till after she has deposited her eggs. The bag containing the eggs remains on the tree throughout the winter firmly attached to the twig by a band of silk. In this way the twigs are often girdled and killed. When abundant, defoliation may be severe and the trees stunted and killed.

The bag-worm may be controlled effectively by spraying with arsenate of lead, three pounds of powder in one hundred gallons of water, as soon as the larvæ have all hatched, that is, some time early in June. In case only a few trees are affected, hand-picking the bags in the fall or early spring is an effective measure.

The gipsy moth (*Porthetria dispar, L.*). Figs. 8, 9.

The gipsy moth is a serious forest and shade-tree pest throughout the greater part of New England. It is a European insect and was introduced into eastern Massachusetts in 1869 where it has become a much more serious pest than in its native home. The winter is spent in the egg state. The egg masses are oval in outline, light brown in color, covered with hairs from the moth's body, and are placed on trunks of trees or in any sheltered place. The eggs hatch in the spring just as the buds are bursting, and the caterpillars feed on the tender foliage. The young caterpillars are not able to feed on the leaves of pine, but the older ones thrive on this food plant.

If other trees are growing with them, the partly grown caterpillars may migrate to the pines, causing a stripping of the leaves. The larvæ become full grown about the first week of July. The full-grown caterpillar is about two inches long; the ground color is dark gray and there are eleven pairs of prominent tubercles on the back. The first five pairs are blue and the last six dark red. There is only one generation a year, the moths appearing the latter part of July.

8. Gipsy larva (*Porthetria dispar*).

The gipsy moth may be controlled in ornamental plantings by spraying the trees with arsenate of lead—five pounds of powder in one hundred gallons of water. The application should be made as soon as the eggs have hatched, as the older caterpillars are more resistant to the poison. Pines are less subject to injury when grown by themselves because the young larvæ do not have jaws strong enough to devour the leaves. The removal of deciduous trees from pine groves will make it easier to protect the latter from the ravages of the gipsy moth. In the winter, trees should be examined carefully for egg-masses and the eggs killed by saturating them with crude coal-tar creosote to which a little lampblack has

9. Gipsy moth.

been added as a marker. It is also good practice to band the trunks with "tree tanglefoot" to prevent the ascent of migrating caterpillars.

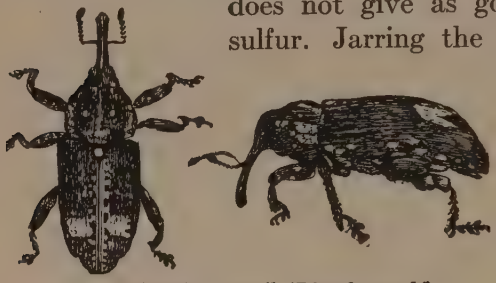
The white pine weevil (*Pissodes strobi*, Peck). Figs. 10, 11.

White pine is subject to the attacks of a weevil which kills the central leader or topmost shoot, thus ruining the symmetry of the tree and causing the trunk to be crooked and misshapen. The parent insect is a small brown snout beetle with a whitish spot near the hind end of each wing-cover. The beetles emerge from hibernation in May and, after feeding for a time on the terminal shoot, they deposit their eggs in punctures in the twig. The eggs hatch in a few days and the larvæ burrow in all directions through the shoot, riddling the tissue and causing the death of the branch. The grubs become full grown in August and the beetles emerge in early fall and go into hibernation under trash and in similar sheltered places. There is only one generation a year.

10. Work of the white pine weevil.

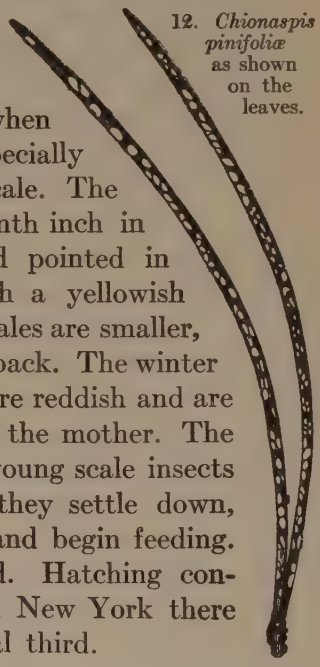
Much may be done to keep the weevils from injuring the pine leaders by spraying this part of the tree about May 1, before the new leaves appear, with lime-sulfur solution—one part in eight parts of water. This acts as a deterrent and

keeps the beetles away. Arsenate of lead—one ounce of powder in two gallons of water—is of considerable value but does not give as good results as the lime-sulfur. Jarring the beetles into a specially constructed insect net is also a practical means of control. The jarring should begin in April or May when the beetles first appear and should be repeated at intervals of one week as long as the beetles are to be found.



11. White pine weevil (*Pissodes strobi*).

Pine-leaf scale (*Chionaspis pinifoliæ*, Fitch). Figs. 12, 13.



12. *Chionaspis pinifoliæ* as shown on the leaves.

Austrian and other hard pines, when grown for ornamental purposes, are especially subject to attack by the pine-leaf scale. The mature female scale is about one-tenth inch in length, elongate, rounded behind and pointed in front. The color is pure white with a yellowish shield at the pointed end. The male scales are smaller, narrower, and have a ridge along the back. The winter is passed in the egg stage. The eggs are reddish and are closely packed under the old scale of the mother. The eggs begin to hatch in May and the young scale insects crawl out on the new leaves where they settle down, insert their bristle-like mouth-parts and begin feeding. A scale-like covering is soon formed. Hatching continues over a considerable period. In New York there are two broods and possibly a partial third.

When this scale is abundant, the growth of the leaves is retarded, they turn reddish, die, and fall off. Infestations as serious as this are rather uncommon, but it is not unusual to find trees which have a distinctly grayish color due to the presence of myriads of the scales.

13. Pine-leaf scale (*Chionaspis pinifoliæ*).

In cases in which the pine-leaf scale is present in threatening numbers, it may be held in check by spraying with nicotine sulfate—one pint in one hundred gallons of water in which four to five pounds of soap have been dissolved. To be most effective, the application should be made soon after the eggs have hatched and before the young insects have formed a protective scale. This will be in May or early June. It has been reported that good results can be obtained by spraying with a miscible oil—one part in sixteen parts of water—in the spring before the buds have started. Care should be taken, however, to do the spraying on a bright, sunny day when there is no danger of freezing and thus avoid possible injury to the foliage.

The pine sawfly (*Lophyrus abbottii*, Leach and others).

The larvæ of several species of sawflies attack the foliage of the pine. The most common species in the East is known as Abbott's sawfly. The larvæ, when full grown, are three-fourth inch in length, yellowish-white in color, marked with rows of rectangular black spots. The eggs seem to be laid over an extended period so that larvæ of different sizes may be found at almost any time throughout the summer. Whole trees may be defoliated, but it is more common to find the

injury restricted to individual branches. The insect passes the winter in cocoons under trash on the ground. There is only one generation a year.

On small trees, jarring the larvæ on to ascreen or some similar device is a good method of control. On larger trees the larvæ may be killed by spraying with arsenate of lead at the rate of three pounds of powder to one hundred gallons of water.

Pine bark aphid (*Chermes pinicorticis*, Fitch).

White pines growing under more or less adverse conditions are especially subject to attack by a small reddish aphid which is rendered very conspicuous by a covering of white waxy material. Scotch and Austrian pines are sometimes slightly infested, but the injury is negligible. The insects confine their attack to the smooth bark of the trunk and branches and congregate at the base of the needles. Badly infested trees become sickly, the leaves turn yellowish and in severe cases the tree may die.

The aphid passes the winter on the bark under the protection of the mass of wax. Early in the spring a cluster of eggs is deposited. The eggs hatch in April and May, the young scatter over the bark, settle down, and become covered with a mass of waxy white threads. On badly infested trees the bark has the appearance of being whitewashed. There are several generations during the season. It is quite probable that this plant-louse has an alternate food plant, but this phase of its life history has not been studied.

The pine bark aphid may be controlled satisfactorily by thorough spraying with kerosene emulsion—one part of standard stock emulsion in nine parts of water. When good water pressure is available, the pest can be held in check by washing the trees with a stiff spray of clear water.

The pitch-mass borer (*Parharmonia pini*, Kellicott).

The trunks of healthy pine trees are often disfigured by large unsightly masses of gum, caused by the larvæ of a beautiful, blue-black and orange, narrow-winged moth which burrows in the inner bark and sapwood. The insect sometimes requires three years to complete its development. It may be held in check by carefully removing the mass of pitch and killing the borer in its burrow.

Spruce gall aphid (*Chermes abietis*, L.). Figs. 14, 15.

Norway and white spruces are subject to attack by a plant-louse which causes the formation of cone-shaped galls at the base of the smaller twigs. These galls are about one inch long and bear a striking resemblance to a small pineapple. The infested twigs may die, and when the galls are numerous the tree may assume a ragged and unsightly appearance. Young trees are most liable to serious injury.

The plant-louse which produces the galls lives over winter in a partly grown condition, hidden away in cracks of the bark around the buds. In the spring these aphids complete their growth and about the middle of May deposit a cluster of approximately three hundred yellowish eggs. These eggs hatch in about a week and the

14. Work of spruce gall aphid—*Chermes abietis*.

young lice crawl to the tender growth where they station themselves on the leaves which have already begun to show indications of the developing gall. The formation of the gall is apparently initiated by the feeding of the parent plant-louse. As the gall increases in size, the leaf tissue grows over the young aphis which thus comes to occupy a closed cell. Within this retreat the aphid passes through four stages; the cell then opens and it escapes. This usually takes place in August. At the last molt the plant-louse acquires wings and then takes her position on a spruce leaf where she deposits a cluster of eggs, leaving her dead body over them as a protection. On hatching, the young lice scatter over the nearby branches and attach themselves to the leaves and in crevices around the buds. It is in this condition that the insect passes the winter.

15. Spruce gall aphid on larch.

It is thought by some that the life history of the insect is not as simple as is indicated above but that there is a regular migration from spruce to larch and from larch to spruce. It is quite probable that a migration does take place when both kinds of trees are growing near each other. In cases in which larches are not present, the insect seems to be capable of breeding indefinitely on spruce.

The spruce gall aphid can be controlled effectively on ornamental plants by thoroughly spraying with whale-oil soap—one pound in two gallons of water. The application should be made during the winter or in early spring before new growths start. A miscible oil—one part in twenty of

PLATE XXIX. Thrifty young specimen of Douglas fir (*Pseudotsuga taxifolia*)

PLATE XXX. Handsome cones of the Douglas fir (*Pseudotsuga taxifolia*)

water—has given good results when used on nursery trees in the early spring. In England a weak kerosene emulsion is sometimes employed. In case spraying has been neglected till too late in the season, much can be done to reduce the numbers of the lice by cutting off and burning the galls before they open. This method is not to be recommended when spraying is possible. When the trees have become infested in the nursery, it is well to fumigate them before planting out.

The Colorado blue spruce is also subject to attack by a closely related gall-forming plant-louse (*Chermes cooleyi*, Gillette). The galls are similar in structure to those caused by the spruce gall aphid, but are more elongate and are at the end of the twig instead of at the base. The same species also attacks Engelmann spruce. Its life history is similar to that of the form previously treated. It may be controlled by the same measures. The fact that this species regularly migrates to red fir and breeds there during part of its life cycle would indicate the undesirability of planting these two conifers on the same or adjoining estates.

Red and black spruces in the East are likely to have the tips killed by the formation of a tight cone-shaped gall which superficially resembles the true cone of the tree. This gall is produced by a plant-louse (*Chermes pinifoliæ*, Fitch) which spends part of its life cycle on the leaves of the white pine, where it is known as the white pine leaf-aphid. Winged forms appear on the pine in May and June and the next generation settle on the young leaves. The lice are covered with a white waxy secretion which renders them conspicuous. They cause the leaves to turn yellowish and may materially stunt the new growth.

On spruce this insect may be controlled by removing and destroying the galls before the lice emerge. On pine, spraying

with whale-oil soap—one pound in two gallons of water—will give effective control. The lice are destroyed in great numbers by insect enemies, and artificial control measures are rarely necessary.

The spruce bud-worm (*Tortrix fumiferana*, Clemens).

The most serious pest of the great spruce forests of the northern United States and Canada is a bud-worm, the larva of a small light-brown, gray-mottled moth. Outbreaks occur at intervals of several years and large areas of forests are defoliated and in many cases killed. At such times ornamental trees do not escape attack, but may be seriously injured by the small caterpillars.

The caterpillars hibernate in an early stage of their development and resume feeding in the spring as soon as the new growth appears. They cut off the needles at the base and then web them together with silk, forming a loose shelter in which they live and continue feeding. The caterpillars become full grown about the middle of June in Maine and pupate within the web. The moths emerge a week or ten days later and lay their eggs in small oval clusters on the spruce needles. The eggs hatch in about a week and the young caterpillars feed on the opening buds. There is only one brood a year.

On ornamental trees the spruce bud-worm may be controlled by spraying in the spring, just after the buds open, with arsenate of lead—three pounds of powder in one hundred gallons of water. The application should be repeated a week or ten days later.

The larch case-bearer (*Coleophora laricella*, Hübner). Fig. 16.

Young, vigorous larch trees are frequently attacked by a small case-bearer that mines in the leaves, causing a yellowish, unhealthy appearance of the foliage. Badly infested trees may

turn brown early in the season and after repeated attacks may die. European larch and tamarack, or American larch, are subject to attack by this insect both in woodlands and in ornamental plantings.

The larva of the larch case-bearer crawls into a leaf which has been burrowed out and carries this case as a protection for its tender body. The insect passes the winter in a partly grown condition within its dark gray cylindrical case. At this time the cases are about one-seventh inch in length and are relatively slender.

16. The larch case-bearer (*Coleophora laricella*).

The hibernating cases may be observed readily on infested twigs, lying flat on the bark or projecting at various angles from the twigs. In the spring the case-bearer migrates with its case to the buds where it burrows as far as possible into the leaf, but retains a hold on the case. One larva will attack and mine a large number of leaves while it is completing its growth.

When full-grown the larvæ attach themselves and their cases to the bark at the base of short side branches where they pupate. The tiny moths emerge two to three weeks later and mate in a short time. Early in June the females begin laying their brown ridged eggs on the leaves of the larch. On hatching the larvæ bore directly through the eggshell into the leaf and burrow in the tissues. Early in September the case-bearing habit is assumed, using for a case either a portion of a leaf already mined or perhaps a new leaf. In either event, the larva lines part of the hollow leaf with silk, cuts off both ends, and migrates to new leaves, carrying the case about in typical fashion. In the

latter part of October they migrate from the leaves to the twigs, where they fasten one end of the case to the bark and hibernate in this condition.

No practical method of control is known for this pest in forest areas. In ornamental plantings, however, a dormant spray of lime-sulfur solution, testing 32 degrees Baumé, diluted at the rate of one part of lime-sulfur to eight parts of water, has given good results. It is advisable to make this application just as late as possible in the spring before the buds start growing.

The larch sawfly (*Lygœonematus erichsonii*, Hartig).

The larch, both under cultivation and in the forest, is subject to severe defoliation by the larva of a sawfly. The insect hibernates as a larva in tough brownish cocoons on the ground under the litter beneath the trees. The sawflies appear in late May or early June. The female inserts her eggs in the young, green, terminal twigs, causing them either to die or to become bent and distorted. The eggs hatch in about a week and the larvæ become full grown in three to four weeks. When abundant, the tree is completely defoliated and the growth seriously checked. The young larvæ are pea-green in color, with dusky heads. When full grown the head is black and the body is glaucous-green. There is only one generation a year. On reaching maturity the larvæ descend to the ground and spin their cocoons under trash or in the ground very near the surface.

The larch sawfly can be controlled effectively on ornamental trees by spraying with arsenate of lead—three pounds of powder in one hundred gallons of water. The application should be made late in May just as the eggs are hatching. When only a few trees are to be protected and when spraying

is objectionable, the insect may be eliminated almost entirely by collecting and destroying the cocoons in the autumn. The soil and litter around the tree should be removed to a depth of an inch or two and carted away. It should be buried or disposed of in such a way as to kill all the cocoons. Isolated trees may be rendered free from attack for several years by this treatment.

Woolly larch aphid (*Chermes strobilobius*, Kaltenbach). Fig. 17.

17. *Chermes strobilobius.*

The leaves of the larch are often badly infested by a small, nearly black plant-louse which covers itself with a conspicuous mass of wax-wool. Infested trees often have the appearance of being dusted with flour.

The life history of this plant-louse is extremely complicated. The insect hibernates both on larch and on spruce and can breed for at least two years on larch, but there is a regular migration between these two trees. On the spruce the lice form galls which are similar to those of the spruce gall aphid. On the larch the over-wintered females and their eggs may be found in abundance in early May at the base of the leaf-clusters. On hatching, the young crawl to the leaves where they settle down and secrete a white waxy covering. The aphids are most abundant in late June although they are present in smaller numbers until fall.

This plant-louse rarely causes enough injury to spruce to make remedial measures necessary. The methods suggested for the control of the spruce gall aphid would be equally applicable to the present species. On larches the aphids may be killed by spraying with kerosene emulsion. In the case of young trees it might be advisable to fumigate them before planting out.

DISEASES AND INJURIES OF ORNAMENTAL CONIFERS.—Dickson

Trees, like all other living organisms, are liable to suffer from numerous diseases and injuries throughout their life, from the time the seeds germinate. Some of these tend to reduce the vigor of the trees or to open the way for more serious maladies; others depreciate their value from a commercial or ornamental standpoint; while others kill them outright. In the forests, diseases cause an inestimable annual loss, due to the ideal conditions for their spreading; but individual conifers, as employed for ornamental planting, are usually fairly healthy as far as actual diseases are concerned. The commonest troubles of such trees are often directly traceable to environmental factors. It should always be borne in mind that trees require care and attention, for when growing under unfavorable conditions they will not thrive and are much more subject to disease than when planted in a favorable environment.

Trees require a considerable amount of water and food. These factors are naturally cared for in the forest by the covering vegetation of the forest floor and the accumulation of fallen leaves and débris which is continually adding to the nutritive contents of the soil. On lawns and in parks, however, such materials are constantly removed for various reasons and it often becomes necessary to compensate for this loss of

natural food by the application of artificial fertilizers. The drainage in such places may be such that trees will suffer from lack of water under certain conditions. This must also be readjusted. Air is another essential for growth and health of trees. This applies as much to the root system as to the aërial portions, for trees are often killed by root suffocation due to the banking up of soil around their butts during grading operations or to the tight packing of the soil. It is not always possible to loosen the soil around trees, but doing so will often add to their vigor and health by conserving the soil-moisture and by permitting the circulation of air among their root systems. Certain other factors, such as too high or too low a temperature, sudden changes in temperature, the presence of smoke or noxious fumes in the air, the penetration of illuminating gases into the soil from leaky mains, lightning, and ordinary mechanical injuries, play an important rôle in impairing the health of trees outside of the forest.

A brief introductory statement concerning the fungi as causal factors in disease will probably help the layman better to appreciate such diseases in the following discussion. The fungi are, for the most part, microscopic plants which possess no green parts and are, therefore, unable to manufacture any food materials for themselves. For these materials they depend largely on the higher plants on or in which they live. The various tissues of the plants are attacked and certain parts of them converted into food for the fungi. During these processes conditions arise which are injurious to the higher plants and which are designated by the term disease, while the plant affected is called the host. Sooner or later, changes consequent on the diseased condition become apparent. Such changes, which may take the form of swellings, wilting, variations in color, death of parts or of the whole plant, dwarfing, and the

like constitute the symptoms of the disease. The fungi, with but few exceptions, propagate themselves by means of tiny structures, invisible to the naked eye, called spores, which are produced in extremely large numbers. Under suitable conditions, these germinate and reproduce the fungus from which they arose.

1. Coniferous seedling diseases and injuries

Damping-off (caused by various fungi).

In most regions damping-off is by far the most serious loss factor in the nursery. All species of conifers are susceptible to this disease, although the junipers are generally considered somewhat more resistant than the remainder. The young root may be rotted off soon after the seed germinates and before the sprout appears above the surface, such losses often being laid to poor seed germination. After the shoot has appeared, a rotted area may develop at or just below the surface of the ground, causing the seedling to fall over, wilt, and die. This happens before the stem has become woody, i.e., before the seedlings are about two months old. At this time, also, the seedling may wilt and die while still remaining erect, due to the rotting of the young root system. A fourth variation in the symptoms is exhibited when the upper part of the seedling only is rotted, infection having taken place before the tip finally withdrew itself from the seed-coat. Of these types, the first two are the most important. Infection in a bed usually commences at certain points and spreads rapidly in all directions from these foci.

This disease is caused by certain fungi (*Corticium vagum*, B. & C., var. *solani*, Burt, *Pythium debaryanum*, Hesse and *Fusarium* spp. being the most usual in this country) which are commonly present in the soil. They become active and

PLATE XXXI. Carolina hemlock (*Tsuga caroliniana*)

PLATE XXXII. Three good spruces (*Picea Omorika; P. orientalis; P. Schrenkiana*)

cause their greatest damage under moist conditions. Control measures should, therefore, aim at the destruction of these fungi in the soil and at the regulation of the surface moisture in the seedling beds. In the case of coniferous seedlings, the application of sulfuric acid has proved the most satisfactory eradication measure, but in applying it attention must be paid to the physical character and natural acidity of the soil. An average strength for use is three-sixteenths of a fluid ounce of clear commercial sulfuric acid to one quart of water (1 part of acid to 170 parts of water), this amount being applied to each square foot of soil immediately after the seed is sown. In the case of open porous soils, from which surface evaporation is rapid, it will be necessary to water the beds once or twice a day to prevent acid injury to the roots. In using this method, it is advisable for the grower to make individual tests on his own soil in order to arrive at the most suitable strength. In addition to preventing damping-off, sulfuric acid will also keep down weeds and cause increased vigor in the seedlings.

Soil alkalinity seems to favor the disease so that the addition of lime and wood-ashes as fertilizers should be avoided. Unrotted stable manure is also likely to increase the loss from this disease.

The surface moisture and temperature may be effectively controlled by inclosing the beds with upright wire-mesh screens and placing laths across the top. These laths may be removed when the surface becomes too moist or replaced to give the required amount of shading. If this does not result in sufficient drying out of the surface, coarse dry sand may be scattered over the bed.

As the crowding of seedlings is an important factor in the spread of the disease, broadcast sowing is recommended.*

*Hartley, C. Damping-off in Forest Nurseries. U. S. Dept. Agr. Bull. 934: 1–99. 1921.

Sun-scorch.

This important trouble occurs on all conifers during the growing season, in hot, dry weather, especially when the seedlings or transplants are dense and the soil is sandy. It is due to more water being given off by the plants than is absorbed by their root systems. In serious cases seedlings of all ages are killed outright, but when it is less severe, only parts of the plants may die. The needles first turn yellow, commencing at their tips, and then gradually become a deeper brown color and finally nearly red. There is a simultaneous death of the root system. Owing to the fact that affected areas are often in well-defined patches in certain beds, the trouble is at times mistaken for one due to a fungous attack. The relation of the blight to the weather conditions, crowding, and soil character will, however, usually help one to diagnose the trouble correctly.

Complete control may be obtained by heavy watering, at least once a week after the seedlings are over two months old. Lath shades, as described under "damping-off," or some other means to the same end, will also prove helpful. Crowding of the seedlings and extremely sandy soil should be avoided.

Whitespot.

A type of injury which may be mistaken for damping-off sometimes appears in coniferous seed-beds in very hot weather, particularly when the soil is very porous and black. Small, somewhat sunken lesions, which are light in color and have quite a definite margin, appear at the base of the stems. The lesion is often only on the side of the stem which faces the south, but it may encircle the whole stem. Seedlings thus affected may remain turgid and upright for several days but sooner or later they fall over and die. This is often due to

secondary fungous attacks which cause a decay and bring about an extension of the original lesion.

For whitespot, which is apparently due to surface heating of the soil, shading and frequent light watering have given satisfactory control. When possible, soils which are porous and of a dark color should be avoided.

Winter-killing.

Winter-killing is very similar to "sun-scorch." It occurs, however, when the ground is frozen so that the roots are unable to supply a sufficient amount of water to the tops during warm periods of winter or in the early spring. It differs also from "sun-scorch" in that open stands are more liable to be affected.

The application of a light straw mulch to the beds and the erection of windbreaks will give control. Care must be taken in the use of a mulch, as injury might accrue from too heavy an application, as described below.

Frost-injury.

This differs from winter-killing in the fact that it is not due to a drying-out effect but to the formation of ice crystals within the unripened tissues of the plant. It results from early frosts which occur before the tissues have matured or from late spring frosts. Certain trees, such as jack pine, commence growth very early in the spring so that the terminal buds and young shoots are often killed by such late frosts.

Very late spring sowing and the forcing of growth toward the end of the growing season should be avoided in order to give the tissues a chance to mature before the advent of frosts. Mulching the beds will also help to prevent injury. Growth should be retarded by shading or some other method in the spring until all danger of severe frosts is passed.

Mulch injury.

When close, heavy mulches are used, the tops of seedlings may die in winter while the mulch is still on or just after it is removed. The roots, however, do not die until some time after the tops. The immediate cause of death is at present unknown, but it may be prevented by care in supplying a mulch which is neither too heavy nor too compact.

2. Diseases and injuries of older coniferous trees

Winter-killing.

This type of injury has been described as it occurs in the nursery. Older trees are also subject to it, especially in mild winters when there is very little snow covering and in the early spring. Owing to the fact that conifers retain their leaves during the winter and, therefore, transpire more freely at the critical periods than do deciduous trees, they are particularly susceptible. The symptoms are as previously described. The needles die from their tips and finally become a reddish-brown color. Many terminal buds are often killed and whole trees are sometimes defoliated. Certain junipers, especially *Juniperus virginiana* and *J. chinensis*, are very capable of withstanding such conditions.

The injury is most likely to occur when ornamental trees with a shallow root system are situated in exposed positions. Mulching should afford satisfactory control.

Frost-injury to roots.

In very severe winters when there is but little snow, the roots of trees may be partially or entirely killed. This is very likely to occur in the case of trees which possess shallow root systems, such as European larch, pines, and hemlock. It is frequent in white pines. If all the roots are killed, the tree

may appear normal in the spring and until the soil begins to dry out; then the death of the tree follows rapidly, usually commencing at the tip of the leader. In the case of a partial killing of the roots, severe sun-scorch may develop with the appearance of the first hot, dry weather.

This injury may be prevented by the use of a mulch when such weather conditions exist.

Frost-injury to the bark.

This is a type of winter-injury which occurs on the sun-exposed side of the trees. Among the conifers, pine and spruce are particularly susceptible. It is thought that repeated freezing and thawing of the tissues of this side of the tree causes the death of patches of the bark which often peel off and expose the sapwood. In some cases, the bark adheres firmly but becomes somewhat sunken so that canker-like areas are produced. These dead spots form suitable places for the activities of various fungi.

In order to prevent the entrance of fungi, the injured bark should be removed by proper tree-surgical methods and the exposed wood protected by a suitable dressing. For this purpose a coating of good shellac should be applied to prevent drying out and when this is dry it should be covered with a coat of tar or thick bark-colored paint. (See under tree surgery.)

Frost-cracks.

Frost-cracks are much more common on deciduous trees than on conifers, although they occur fairly frequently in the case of the spruce and fir. The cracks appear as longitudinal slits running for some distance up and down the trunk on the sunny side, and are caused by sudden falls in temperature. They open wider during cold weather, while during warm periods they may completely close up. They are chiefly of

importance in that they provide avenues for the entrance of fungi which may cause serious wood-rots.

Cracks of this type will usually heal over naturally unless they are repeatedly reopened by low temperatures. The healing may be hastened, however, by using staples to close the wound. The exposed surfaces of wood and bark should be sterilized and waterproofed (see under tree surgery) in the winter when the crack is wide open. The stapling should be done in the spring when the wound is closed. Staples may be made of iron, about three-eighths of an inch in diameter, and should be four to five inches wide and about the same length. The bark and wood is removed to allow the staples to be driven in flush with the wood, and the exposed tissue should be treated with creosote and tar or thick bark-colored paint. The staples should be about two feet apart, and better results will be obtained if the points are bent slightly inward.

Sun-scorch.

This is also similar to the trouble described under the same name in connection with seedling diseases. In its effects it resembles winter-drying, but it occurs during the summer months. It usually becomes evident after high winds on hot days. The needles on the exposed side of the trees become yellow and then brown from their tips, giving the tree a scorched appearance. Norway spruce, Douglas fir, pines, white-cedar, and arbor-vitæ are more commonly affected.

Sun-scorch is a result of drought conditions brought about by excessive transpiration. To a considerable extent such injuries are unavoidable, but they may be lessened by any measures which tend to keep the soil moist and well aërated. Mulching, when practicable, is beneficial, especially when combined with artificial watering.

Smoke and fume injury.

In manufacturing cities and in the vicinity of smelters, pulp and fertilizer mills, brick-kilns, coke-ovens, and blast-furnaces, particularly where sulfur gases are produced, the effects on all kinds of foliage are very evident. Evergreens in general are most sensitive, probably owing to the long life of their individual leaves. Junipers, however, show a distinct resistance, while pines and firs are much more susceptible. The degree of injury is governed by the distance from the source of the smoke and fumes, by the direction of the prevailing winds, and by the topography of the ground. Injured trees show a dying and browning of the needles from their tips. There may also be a curling of the leaves, while the trees are generally stunted and of a sickly appearance. The injury may result in defoliation and ultimate death of the trees.

Unfortunately, there is no control measure for this trouble within the power of the individual grower. It is a case of either smoke and fumes or trees having to go. Smoke and fume prevention on the part of the manufactories concerned is the only remedy if the more susceptible evergreens are to be grown. The planting of junipers in districts in which the trouble is most acute should be considered.

Electrical injuries.

Electrical injuries may be divided into those due to the natural phenomenon of lightning and those caused by high tension line wires.

The common effects of lightning are probably familiar to all; but trees may be injured in a number of freakish ways, some of which are more difficult of diagnosis. Sometimes trees are cleft longitudinally or are completely shattered by very powerful discharges. When these are less powerful, strips of

bark may be torn from the trunk, either in continuous lines or at various isolated points. The whole or a portion of a tree may be killed, and this often takes place without any external signs of injury. It is probably due to a killing of the root system or to a girdling of a large or small zone of the living tissues. Many trees are struck, however, which show no ill effects to the untrained observer. There is apparently no difference in the susceptibility of the various kinds of trees to injury by lightning, but it is more likely to occur on those which are more or less isolated on high ground and which have deep root systems.

High-tension line wires may cause a local burning or a partial destruction of trees, due to leakage from the wires when they are in contact with the trees or when they are poorly insulated. This leakage occurs particularly in wet weather when there is a film of moisture on the surface of the tree. In rare cases, trees may be killed outright.

Apart from their unsightly character, such wounds, unless properly cared for, allow many destructive fungi to gain access to the wood of the tree. They may easily be prevented by insisting on the proper insulation of the wires.

Injury due to illuminating gases.

There are several kinds of gases used for illuminating and heating purposes, such as water gas, coal gas, gasoline gas, acetylene gas, and others, all of which are more or less poisonous to vegetation. The injury caused to trees is due to leaky mains, from which the gases penetrate into the soil about the root systems. Certain of the substances are absorbed with the soil-moisture, producing various reactions in the tissues of the trees. Conifers are very resistant to gas poisoning and may completely recover from an exposure.

PLATE XXXIII. An old Norway spruce (*Picea Abies;* or *P. excelsa*)

PLATE XXXIV. Norway spruce (*Picea Abies*). Top, the foliage. Center, var. *Clanbrasiliana*. Below left, var. *pendula;* right, var. *microsperma*

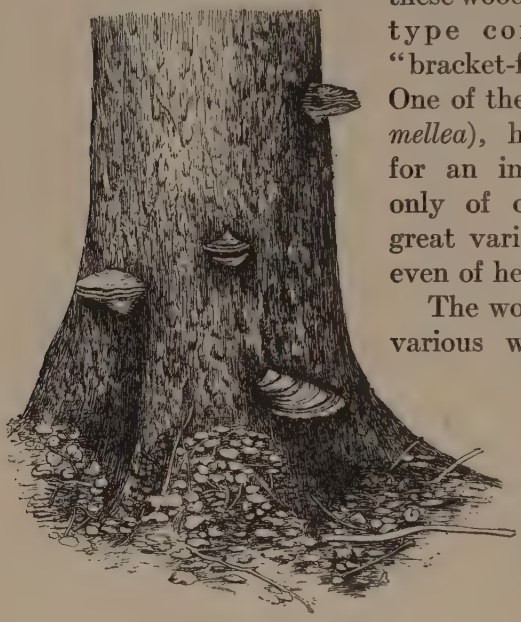
Injury from this cause is very difficult to diagnose in the living tree, as the symptoms are very diverse and many of them are also exhibited by trees which are declining for other reasons. A general sickly appearance, with yellowing or browning of the leaves and probably partial defoliation, may first be seen. This usually commences at the top of the tree and progresses downward. The twigs become brittle and lose their bark, and this shedding of the bark may continue until a large portion of the trunk is bare. Unless the trouble is remedied in time, death of the tree results. If a tree is deteriorating and no other cause of injury can be found, the above symptoms would warrant one in suspecting illuminating gases as the causal factor, but no degree of certainty could be felt without a careful examination of the tissues. The wood shows a marked brittleness, while the tissues outside of the wood are dry and brown. The roots, naturally, are the first parts to be affected. The wood of affected trees possesses a characteristic odor for one who is familiar with this trouble. One would also be able to detect the smell of gas in the soil.

If the injury is very extensive, it is doubtful whether any remedial measures will be effective in saving the trees, although, as mentioned above, conifers may recover after considerable exposure. If only a portion of the roots is affected, they should be removed. After the leak has been repaired, the soil should be dug up and well aërated for several days or, better still, it should be replaced by other soil which is not impregnated with the gases.

Wood-rots.

While very serious losses occur in coniferous trees in the forest, due to several destructive wood-rots, these diseases rarely cause much damage to individual ornamental specimens.

This is due to the fact that the conditions for the spreading of the causal fungi are ideal in the forest, but are much less favorable outside of these domains. Most of the fungi causing these wood-rots are on one general type commonly known as "bracket-fungi" or "polypores." One of the toadstools (*Armillaria mellea*), however, is responsible for an important root-rot, not only of conifers but also of a great variety of other trees and even of herbaceous plants.



18. Sporophores on trunk of tree.

The wood may be attacked in various ways. The heartwood alone may be decayed to a greater or less extent. This may take place in the roots, at the butt or higher up in the trunk and branches. In most cases, the parts attacked are so weakened that the tree is eventually uprooted or broken off by the wind. Less commonly, the sapwood and bark of living trees are also attacked and rotted. In such cases, death of certain parts or of the whole tree may ensue, due to an interference with the passage of food materials.

Infection takes place through injuries exposing the heartwood or sapwood, as the case may be. Spores of the fungi concerned, falling on the injured spots, germinate under suitable conditions, producing a small tube which penetrates

into the wood. Here it continues to grow and causes the wood to disintegrate in a typical manner. Usually no external evidence of the disease is apparent until the fruiting structures (sporophores) of the fungi appear on the injured part, and this does not occur until one or more years after infection. By that time one may generally consider that the rotting of the wood is well advanced.

The fruiting structures of the polypores are commonly known as "punks" and usually project as bracket-like bodies from the surface of the tree (Fig. 18). In some cases they may appear as sheets more or less appressed to the surface. The under side of these bodies is covered with minute pores which are the openings to tubes. Within these tubes millions of spores are produced, which at maturity are shed through the openings. When the sporophores arise near the base of the tree, one may often see the ground covered by a thick brown dust made up of these spores. The wind carries them to other trees, where fresh infections may be initiated.

In the case of the toadstool referred to above, the sporophores arise from exposed or superficial roots or as clusters around the base of the tree. They possess a stalk and a cap which is honey-yellow in color and for this reason the fungus is often called the honey-mushroom. The stalk is somewhat swollen at the base and just below the cap it is encircled by a fragile collar. The spores are produced on the sides of plates or gills on the under surface of the cap (Fig. 19). The base of the stalk is connected with the tree roots by means of round black strands which have the appearance of shoe-strings. These grow through the soil from the roots of one tree to those of another, penetrate the bark and produce infection. Spores may also cause infection through wounds at the base of the tree or in exposed roots.

The wood-rots which attack coniferous trees are too numerous to be dealt with in detail, but all conform more or less closely to the general description given above. The following are some of the more important fungi which are responsible for these rots:

Trametes pini, Fries, causes a destructive rot of fir, spruce, larch, and pine. The heartwood, sapwood, and bark are attacked and trees are often killed. The common name for the disease produced is "ring-shake," on account of the fact that complete annual rings are rotted.

Fomes pinicola, Fries, occurs less frequently on living trees, but is common on those which have been killed or weakened by other agencies. It causes a sapwood rot in which the wood becomes powdery and red-brown in color.

Fomes roseus, Fries, attacks fir, juniper, larch, spruce, pine, hemlock, and arbor-vitæ, causing a brown heart-rot.

Echinodontium tinctorium, Ellis and Everhart, is important in the West where it causes a peculiar heart-rot in fir, spruce, and western hemlock. The spring wood is particularly attacked, causing the annual rings to become separated into disconnected cylinders. Finally the summer wood also is destroyed, leaving the trees hollow.

Polyporus Schweinitzii, Fries, causes a rot of the heartwood in the roots and butts of pine, fir, spruce, hemlock, larch, and arbor-vitæ. It often results in the uprooting of the trees by wind.

Armillaria mellea, Quelet (Fig. 19), is more common on deciduous trees but attacks pine, larch, and hemlock, causing a rot of the bark and sapwood of the roots. The rot may also extend to the butt. The final result is usually the death of the trees attacked, but this may not occur for several years.

Fomes juniperinus, Schrenk, is responsible for a heart-rot of junipers which often makes the trees hollow.

Mechanical injuries should be avoided, for these open the way for the entrance of wood-rotting fungi. All wounds should be carefully cleaned out, disinfected, and coated with some such dressing as coal-tar or asphaltum (see under tree surgery).

All fruiting bodies should be destroyed as soon after they begin to form as possible. This will not arrest the decay in the diseased individual, but will prevent the spores from infecting other trees. Other sporophores will be produced later and these should be consistently destroyed.

19. Fruiting body of *Armillaria mellea.*

In cases in which the value of the tree justifies the expense and when the decay is not too far advanced, the diseased wood may be removed. This should be done by a capable person using proper tree-surgical methods. Such treatments are expensive and it should always be remembered that it is now possible to transplant large trees at a comparatively low cost.

Special treatment is necessary in the case of the root-rot caused by *Armillaria mellea.* If the disease is discovered in the early stages, there are reasonable chances that the tree may be saved. All the soil should be removed from the butt and main roots. The bark should then be removed from the butt with a sharp knife and all diseased roots traced out as far as possible, cut off and burnt. The exposed surfaces on the butt, including all scars caused by the removal of roots, should be sterilized with creosote and waterproofed with a good coating of tar or asphaltum before the soil is returned. It is advisable to leave a fair portion of the root system (about

eighteen inches from the butt all round) uncovered for an indefinite period when replacing the soil. When a number of trees are growing in close proximity, diseased individuals should be isolated by digging a trench about two feet deep all around them just beyond the limits of their root systems. No roots or fungous strands should be allowed to cross this trench.

Trees in which the disease is well advanced should be sacrificed immediately and burnt on the spot. The soil should then be turned over and treated with a generous dressing of quicklime. This area should remain unplanted for at least three years, during which period the soil should be repeatedly turned over and exposed to the sun.

Rusts.

Of the fungous diseases to which coniferous trees are susceptible, it is probable that the rusts are of the greatest importance from an ornamental standpoint. The leaves, twigs, and branches or trunk may be affected with varying degrees of injury, resulting in a serious depreciation in the ornamental value of the tree or even in its death. The important rusts occurring on conifers may be divided into two groups—the "blister-rusts"* which are particularly encountered on pines, and the "Gymnosporangium rusts" which attack junipers and cedars. The fungi causing these diseases are extremely interesting on account of their complicated life history, for the completion of which two different hosts are required. This will be brought out in connection with the discussion of the typical examples below.

White pine blister-rust (Fig. 20) is caused by the fungus

*Only a few of the many forms can be mentioned. For a more complete list the following publication should be consulted: Rhoads, A. S. et al.—Host relationships of the North American rusts, other than Gymnosporangium, which attack conifers.—Phytopathology 8 : 309–352. 1918.

Cronartium ribicola, Fischer, which is a most formidable enemy of the white pines (i. e., those in which the needles are in fascicles of five). Without doubt all five-needled pines are liable to be attacked if exposed to the pathogen. The fungus was first found in North America at Geneva, New York, in 1906, but it is probable that it was present for some years prior to that date. Until the summer of 1921 it was confined to New England, New York, and the Lake States where it has caused very serious losses on the eastern white pine (*Pinus Strobus*). In spite of all efforts to prevent its spread to the valuable stands of western white pine (*P. monticola*) and sugar pine (*P. Lambertiana*) in the Western States, the disease was discovered in western British Columbia and in northwestern Washington in 1921.

20. White pine with blister-rust.

In addition to the five-needled pines, the fungus also attacks wild and cultivated species of currant and gooseberry. Although all species of Ribes are more or less susceptible to attack, the cultivated black currant (*Ribes nigrum*) takes the disease most severely. The currant and gooseberry are known as "alternate hosts," inasmuch as the fungus must pass a portion of its life upon one of these before fresh pines can become infected.

Pines of all ages are susceptible to the disease. The fungus gains entrance at the bases of leaf-fascicles or directly through

the bark of growth which is not more than three years old. From these points it passes down into the larger branches or even into the main trunk where it is able to grow in bark thirty to thirty-five years of age. Here the fungus continues to spread until, finally, girdling takes place with the resultant death of all parts beyond the point affected. Infection is brought about by spores which are blown by the wind from leaves of currants and gooseberries in the summer and autumn. One of the most troublesome characters of the disease is that outwardly visible symptoms are not evident for approximately two years after infection, and then only by careful observation may one discern a slight swelling of the bark in the diseased area. Later, usually about three years and six months after the date of infection, the blisters from which the disease gets its name push through the bark. These creamy-colored sacs appear in the spring and soon break open and liberate millions of yellow spores which may be carried as far as seven miles by the wind. They are unable to reinfect pines, but, falling upon leaves of currant or gooseberry, may produce the disease there. In the early summer, upon the under side of such leaves, yellow pustules appear which produce myriads of another type of spore. These spores, which are produced throughout the summer, are also unable to infect pines, but serve to spread the disease to other currant or gooseberry leaves. In the late summer small, brown, hair-like projections arise from the same spots on the under surface of the leaves. They may be so numerous as to give a brown felt-like appearance to the leaves. These hair-like projections consist of masses of a third kind of spore which soon germinates where it is, to produce yet a fourth type—the sporidia. Sporidia are unable to reinfect currants or gooseberries. Blown by wind, they may infect pines within a radius of not more than 600 yards.

PLATE XXXV. Firs and retinospora (*Abies alba; A. lasiocarpa; Chamæcyparis pisifera* var. *plumosa*)

PLATE XXXVI. White spruce (*Picea glauca;* or *P. alba*)

From what has been said it is evident that the removal of all Ribes plants, both wild and cultivated, from the vicinity of white pines will ensure against infection. This removal must be thorough and, under normal conditions, should be carried out within a radius of 200 to 300 yards.

In the case of valuable ornamental white pines which are already infected, experiments have shown that the removal of infected parts is financially practicable if the treatment is applied in time, and is carried out in conjunction with the eradication of Ribes. The best results will be obtained if the work is done from April to June when the cankers are more easily found because of the bright orange-yellow blisters. The workmen must be thoroughly familiar with the disease, as the success of the treatment depends on the finding of all cankers and the accurate determination of the edge of the diseased area. Diseased twigs and branches should be cut off seven or more inches back of the orange-yellow blisters. If none of these is present, the branches should be cut off five or more inches back of the extreme edge of the canker and flush with the next whorl of healthy branches. On large limbs and trunks, infections which have not passed completely round may be treated by removing all the diseased bark and a strip at least two inches wide at the sides and four inches at the ends of the apparently healthy bark from around the edge of the canker. Large wounds should be protected from the attacks of other fungi and insects by a covering of shellac and bark-colored paint. If the tree is nearly girdled, or if most of the branches must be removed, it is useless to attempt to save it.*, †

*Spaulding, P. Investigations of the White Pine Blister Rust. U. S. Dept. Agr. Bull. 957 : 1–100. 1922.

†Martin, J. F. et al. Treatment of Ornamental White Pines infected with Blister Rust. U. S. Dept. Agr. Circ. 177 ; 1–20. 1921.

Oak rust* is caused by the fungus *Cronartium cerebrum*, Hedgcock and Long, and affects many two- and three-needle pines, especially the scrub, jack, Sabine, Monterey, and knob-cone. Large gall-like swellings are produced on the branches or trunk, and in some cases witches'-brooms are formed. The alternate host is the oak, the leaves of which are infected by the spores from the pines.

Some two- and three-needle pines, especially the lodge-pole and western yellow, are injured by Castilleja rust, which is caused by the fungus *Cronartium coleosporioides*, Arthur. On western yellow pine it has been found to cause serious losses in some nurseries, where the alternate host, *Castilleja miniata*, is an abundant weed. Extensive swellings of the branches and trunk are produced, somewhat resembling the previous disease in this respect.

Sweet-fern rust is destructive in some nurseries. It occurs on two- and three-needle pines, giving rise to symptoms very similar to those described under the white-pine blister-rust. The alternate hosts are the sweet fern (*Comptonia asplenifolia*) and sweet-gale (*Myrica Gale*).

Rust witches'-broom of spruce is caused by a Melampsorella species which has its alternate stage on Alsine (sandwort), Cerastium (mouse-ear chickweed), and Stellaria (chickweed). The disease is wide-spread and very harmful in some localities on Engelmann, Norway, black, Colorado blue, and Sitka spruce. It not only attacks and stunts the twigs and branches of young trees, but also brooms and dwarfs saplings and older trees.

Rust witches'-broom of fir causes harmful brooming and dwarfing of the tips of various species of fir (Abies). Cerastium and Stellaria are again the alternate hosts.

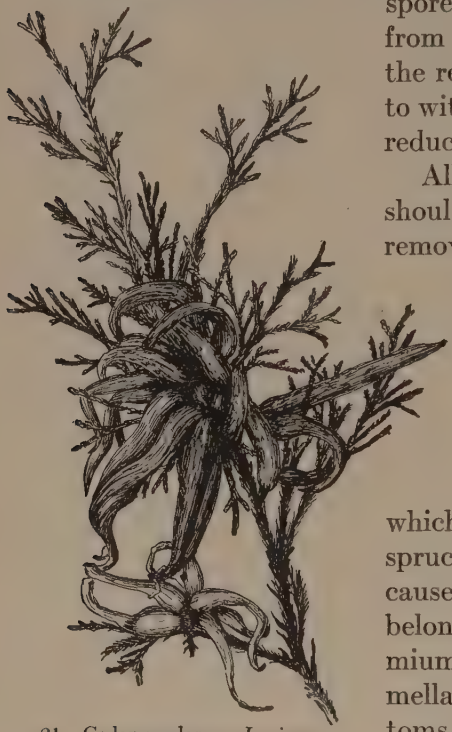
*The existence of the fungi causing these diseases depends on the close proximity of the coniferous and alternate hosts. Control measures will be as outlined under "White pine blister rust."

Several native cedars and junipers and some of their horticultural varieties are attacked by a number of fungi belonging to the genus Gymnosporangium. For the completion of the life cycle of these fungi, certain broad-leaved trees and shrubs, such as apple, pear, quince, hawthorn, mountain-ash, juneberry, fire-thorn, are essential, and, upon some of these, serious diseases are also caused by the fungi concerned. One type of spore is produced on the junipers and cedars and another type upon the broad-leaved hosts. Neither of these spore-forms is able to reinfect the same host on which it was produced, but must pass to the alternate host. The association of the two kinds of hosts is, therefore, necessary for the spread of the disease from one tree to another.

The leaves and young branches of the junipers and cedars are infected by spores from the alternate host. During the second season after infection abnormal overgrowths appear in the form of swellings of the branches and trunk, witches'-brooms (i.e., compact clusters of small branches), or transformations of the leaves into galls commonly known as "cedar-apples" (Fig. 21). In a few cases no overgrowths are developed, the only visible symptoms being a yellowing of the leaves. The "cedar-apple" type of abnormality is most frequent upon the red-cedars and junipers which are used for windbreaks or for decorative planting in yards and gardens in the proximity of orchard trees. The spores of this stage are produced upon these diseased parts in the spring.

In the case of the broad-leaved hosts, the leaves and fruits are attacked in the spring. Small localized spots of a yellowish color appear, and later long whitish tubes of fungous material are pushed out all over the surface of these spots. Within the tubes, the spores which are able to infect the coniferous hosts are produced.

Segregation of the two types of host for these fungi, when it is possible, tends to hold the disease in check. While the spores may be blown for distances from a few feet up to several miles, the removal of the pomaceous host to within a distance of one mile will reduce infection to a minimum.



21. Cedar-apples on *Juniperus virginiana.*

All diseased parts on either host should be carefully and consistently removed as soon as discovered. This will reduce the sources from which the infecting spores arise.

Leaf-cast diseases.

This name is applied to a group of similar diseases which occur on pine, larch, fir, spruce and juniper and which are caused by a number of fungi belonging to the genera Lophodermium, Hypoderma, and Hypodermella. In general, the later symptoms resemble very much those caused by sun-scorch and winter-killing. Small yellow spots or bands first appear on the leaves and these are followed by a browning of the entire needles. In the spring, fruiting bodies of the fungi appear as black lines or roundish dots along the middle of the dead leaves on the lower side. These bodies contain the spores which are discharged through elongated openings and which are blown about by the wind to other trees. The leaf-cast diseases are

often serious on small trees since they may cause complete or nearly complete defoliation.

All fallen needles should be gathered up and burned. Spraying with a 4–4–50 bordeaux mixture before rain periods will also reduce the infection in the nurseries.

3. Tree surgery

In the care of ornamental trees the following points should be remembered:

1. The wood of a tree is naturally protected by the covering of bark. Any injury to this, or any exposure of the wood, affords an opportunity for the entrance of destructive organisms which may bring about extensive damage, resulting sometimes in the complete loss of the tree.

2. Early attention to small injuries will render unnecessary expensive treatments in the future.

3. More harm than good is often caused by allowing inexperienced workmen to do tree-surgery work.

Whether or not a tree shall be treated surgically will depend on two main factors. In the first place it must be decided whether it is possible to save the tree—a question which can be answered only by one who is thoroughly familiar with the trouble with which it is afflicted. In some cases it will be better to replace the tree rather than to try to save it. Secondly, the expense must be taken into consideration. The amount one is willing to spend on a certain tree will, of course, depend on its value from an esthetic or historical standpoint. All ornamental trees are, however, worth considerable care, for they add greatly to the value of real estate.

There are a few fundamental principles underlying all tree-repair work. The first essential is that all diseased or dead bark or wood must be removed. In the case of fungous

attacks, it can be accepted as a general fact that the organism is present not only in the tissue which actually shows the disease to the naked eye, but also for some distance beyond this area in all directions. A certain amount of apparently healthy tissue should always be removed, therefore, in order to ensure the complete eradication of the fungus. All cut surfaces should then be sterilized and protected from drying out and from the attacks of other organisms. This will involve the examination of the treated parts from time to time so that any defects may be remedied immediately. A neglect of this precaution may nullify all previous work done. Finally, all the treated portions must be left in the most favorable condition for rapid healing.

Removal of branches.

When small branches or twigs are the parts diseased, it will be the simplest procedure to remove them entirely. In doing this, no stubs should be left, for they are both unsightly and a source of danger to the future health of the tree. Diseased branches should always be cut off with a wide-toothed saw flush at the point where they join healthy ones, care being taken not to strip the bark below. The surface of the wound should be trimmed with a sharp knife and the scar pointed above and below. Following the knife, the exposed sapwood and bark should be covered immediately with a coating of good shellac. This will serve the double purpose of preventing the drying out of these living tissues and also the excessive exudation of resin which takes place from the wood of some coniferous trees. (The resin secreted by such trees is sometimes smeared over the cut surfaces to take the place of other dressings; but, while it serves well as a protective covering, it usually runs down the bark of the tree, leaving unsightly white streaks.) The exposed heartwood should now be sterilized

with ordinary commercial creosote and the entire shellacked and creosoted surface finally waterproofed with thick coal-tar or asphaltum. Should the color of the tar be objectionable, it may be replaced by a covering of thick bark-colored paint. This will need careful watching, however, for paint has a tendency to crack, and such cracks are sufficient to permit the entrance of fungi.

Removal of bark.

In many cases, the larger limbs or the trunk of the tree are attacked, either in the living portions or in the heartwood, thus necessitating the local removal of the diseased tissues. The excavation of the heartwood would not in any way interfere with the life processes of the tree, but, as the sapwood and bark are the channels through which water and food materials pass up and down the tree, they must be conserved as far as possible. If the diseased area extends more than two-thirds of the way around the trunk or limb, it is doubtful whether treatment would be possible, for, as has been pointed out above, a portion of healthy tissue must always be removed as a safety zone.

In peeling off diseased bark, a sharp hook-pointed knife is most useful. The bark is first cut through to the wood around the margin of the area to be removed, making it V-shaped above and below. The bark is then peeled off and the edges trimmed with a sharp knife. As soon as the exposed surface is sufficiently dry, it should be covered with a coating of shellac and waterproofed with thick bark-colored paint, tar, or asphaltum.

Cavity work.

Removing diseased wood involves the making of a cavity and requires expert workmanship if the best results are to be

obtained. Such treatment is usually rendered necessary through neglect of small injuries and especially through the leaving of branch stubs, by way of which fungi reach the heart of the tree and there initiate destructive rots. The full details of this branch of the subject cannot be entered into here, but they are given in readily available form in the publication mentioned below.* The fundamentals, however, may be summarized as follows:

All diseased wood must be removed, together with a certain amount of apparently healthy tissue. In doing this it will be necessary to cut away a portion of the bark, but the hole made should be no larger than is absolutely essential. The edge should be trimmed and the opening pointed above and below to facilitate healing over. The exposed sapwood and bark should then be sealed with a coating of shellac and the remainder of the exposed wood sterilized. For this purpose, creosote is one of the best preparations, but it must not be used on the bark. The whole shellacked and creosoted surfaces are then covered with a thick coating of tar or asphaltum. The bottom of the cavity must be so shaped that water will run out readily and this will sometimes necessitate the filling up of this part of the cavity to give the requisite slope.

This completes the essential operations in the treatment of such wounds. Regular inspections should be made at least biennially and if there is any cracking of the waterproofing material a fresh coat should be applied. An open cavity is much better for this reason, in that it allows one to make thorough inspections from time to time. From an ornamental standpoint, however, it may sometimes be advisable to fill such cavities. For this purpose, asphaltum or cement are most commonly used. The opening to the cavity may also

*Collins, F. J. Tree-Surgery. U. S. Dept. Agr. Farmers' Bull. 173 : 1–29. 1920.

be covered with sheet tin, zinc, or iron, but the practice is not to be recommended.

4. Fungicides

Spraying or dusting are of value in the control of leaf diseases in the orchard and in the field, but very little information is available concerning the application of these measures to ornamental trees and shrubs. There seems to be no reason, however, why they should not be effective. Fungicides should be applied before rainy periods and before infection has taken place (except in the case of surface fungi such as the mildews), for they are generally preventive and not curative agencies. The three commonest fungicides are bordeaux mixture, lime-sulfur, and sulfur.

Bordeaux mixture consists of a mixture of copper sulfate (blue vitriol) and milk of lime, the active principle being the metallic copper. A stock solution of copper sulfate is made by dissolving the required number of pounds of crystals in as many gallons of water. This is most easily accomplished by placing the crystals in a bag and suspending this just below the surface of the water. A wooden container should be used for this solution, as it rapidly corrodes metallic surfaces. The milk of lime is prepared by slaking stone lime and gradually adding water until a thick smooth paste is obtained. Sufficient water is then added to make the number of gallons equal the number of pounds of lime. The spray is used in various strengths, 4–4–50 being the average. This formula signifies that four pounds of copper sulfate, four pounds of lime, and fifty gallons of water make up the mixture. In preparing fifty gallons at this strength, four gallons of the stock copper sulfate solution should be placed in the tank and then thirty-two gallons of water added. After this has been done, the four

gallons of lime are added and the whole thoroughly stirred. The mixture is then ready for use.

Self-boiled lime-sulfur is prepared by placing eight pounds of good stone lime in a container and adding sufficient water to start it slaking. Eight pounds of sulfur are then added slowly, working it through a sieve to break down the lumps. The lime should be prevented from burning by the addition of water, but care must be taken not to drown it. When the slaking is complete, the container is filled up to fifty gallons and the mixture strained through a sieve of twenty meshes to the inch. This solution may be used in cases in which bordeaux mixture causes injury to the foliage. While applying, the mixture should be constantly agitated, as it settles out very rapidly.

Copper-lime dust and lime-sulfur dust may be obtained from manufacturers of fungicides. They have the same value as the sprays mentioned above, but are applied in the dry form.

"Flowers of sulfur" or finely-ground sulfur flour may be used in the case of superficial fungi, such as the mildews. It should be dusted over the affected parts when they are wet. It is most effective in hot, dry weather.

PART II

THE KINDS OF CULTIVATED CONIFERS (GYMNOSPERMS) IN NORTH AMERICA

By ALFRED REHDER

To make the treatment complete for the group, all the conifers known to be regularly in cultivation in this country outside botanic gardens are included in this account, even though some of them, as the larches and one of the bald cypresses, are deciduous.

CHAPTER V

A SYSTEMATIC ENUMERATION OF THE CONIFERS CULTIVATED IN NORTH AMERICA

THE group of plants known as conifers, popularly often called evergreens, belongs, together with the Cycads and Gnetaceæ, to the division of Gymnosperms which is chiefly distinguished from the other phenogamous plants or Spermatophytes by the ovules not being inclosed in an ovary. The conifers are now usually divided into three families of which the first, Ginkgoaceæ, the Ginkgo family, is closely related to the Cycads in its mode of fertilization, which is by motile sperm-cells, while in the Taxaceæ and Pinaceæ, fertilization is effected by means of passive sperm-cells developing long pollen-tubes as in the other phenogamous plants. The Taxaceæ differ from the Pinaceæ chiefly in the fertile flower, which consists of few or only one carpel with one or two ovules developing into a drupe-like seed usually exceeding the carpels, while in the latter family the flower consists of usually numerous carpels and develops into a cone-like fruit with mostly winged seeds inclosed between the carpels.

All the conifers are woody plants, sometimes attaining great dimensions. They inhabit chiefly the colder and temperate regions of the globe where they usually form the predominant components of the forests. Among them are the most important timber trees of the northern countries, and as ornamental trees they are particularly valuable in colder sections as they are the only evergreens attaining to a large size and are indispensable for the creation of evergreen woods and shelter-plantations.

The scope of this work does not permit the bringing out of

the very interesting facts connected with the history and particularly with the introduction of the different species into cultivation. In most cases, only the date of the first introduction into cultivation has been given, and these dates concern chiefly the introduction into European gardens. It is to be regretted that very few data are available regarding the introduction of plants into American gardens except those of recent date; it would certainly prove to be an interesting and fascinating study to trace the historical development of the plant material of our gardens and the various attempts to introduce plants from foreign countries and to bring those of our own rich flora into cultivation.

NOMENCLATURE, SEQUENCE, AND KEYS

In the following account of conifers, descriptions are given of only the species and varieties which are actually or are supposed to be in cultivation in North America, but many others are mentioned incidentally. In regard to the botanical names, the International Rules of Botanical Nomenclature are followed and have been strictly applied, but in cases in which the name adopted in the Official Catalogue of Standardized Plant Names (prepared by the American Joint Committee on Horticultural Nomenclature), intended as a guide for nurserymen and horticulturists, differs, that name is given as an alternative and may be used instead of the name considered correct under the International Rules by those who prefer to follow that Catalogue. The English names used here are those proposed in that Catalogue.

As the present treatment is intended chiefly for horticultural purposes, it has not been considered necessary to group the varieties and forms from a strictly botanical point of view and, therefore, no distinction has been made between subspecies,

varieties, forms, lusus, and other subdivisions; all subdivisions of a species are uniformly designated as "variety"; in general usage this term is often dropped and the varietal name directly joined to the specific name, e. g., *Chamæcyparis pisifera plumosa* instead of *C. pisifera* var. *plumosa*, although this is not strictly correct. No attempt has been made to substitute new names for combinations like *Chamæcyparis pisifera* var. *plumosa aurea;* such names have been retained for horticultural purposes and placed in quotation marks to indicate that the writer does not consider them botanical combinations. They are, moreover, inadmissible under the International Rules, because the name *aurea* cannot be used, since there is already a variety *aurea*, namely *C. pisifera* var. *aurea*, Carr. According to the Rules, a name can be used only once for a subdivision of any one species, otherwise it would not be possible to designate every subdivision of a species by only three names: the generic, the specific, and the varietal name. The introduction of several subordinate varietal names into a combination is justified only if it is necessary or desirable to indicate the systematic position of a certain form in a polymorphous species, but for the simple designation of a plant the names of the intervening divisions are often dropped. Combinations of four or more names are cumbersome and have done much to discredit the Latin nomenclature of horticultural forms, which, after all, is the simplest way to give a definite place to a plant and is understood the world over.

In the following systematic account the genera under their families are arranged, as much as feasible, in a linear sequence, according to their supposed natural relationship and under each family a conspectus or key to the genera is given, chiefly based on characters of the flower and fruit, to give a clearer understanding of their relationship and to serve as an ex-

planation for the sequence of the genera as adopted. As these keys are of use only if flowers or fruits are available, another key to the genera of all three families combined and based on vegetative characters only is given below. This should make it possible to determine any coniferous plant even without flowers or fruits. There may be, however, some cases in which the key may fail, particularly if only young seedling plants are available, since in many conifers, chiefly in the Cupressineæ and Taxodineæ, the foliage in its juvenile stage is very different from that of the adult, as may be seen if *Chamæcyparis pisifera* and *C. pisifera* var. *squarrosa* are compared; even the arrangement of the leaves may change, as in *Widdringtonia Whytei* which has alternate leaves in its juvenile stage and opposite in the mature plant; also some other abnormal garden forms show a great deviation from their type. Furthermore, some species and even a few genera show such a great resemblance in their vegetative characters, though different enough in flowers and fruits, that it is almost or quite impossible to give an accurate description of these differences which, however, may usually be perceived if the plant in question can be compared with correctly named specimens or plants.

KEY TO THE GENERA OF CONIFEROUS PLANTS BASED ON VEGETATIVE CHARACTERS

A. Plants with evergreen foliage.
  B. Leaves alternate, scattered or clustered.
    C. Arrangement of leaves scattered.
      D. Form of leaves linear, lanceolate, or subulate, rarely oblong to elliptic.
        E. Winter-buds not scaly or with green or greenish scales: leaves decurrent into a green leaf-cushion, not articulate at base.
          F. All the leaves flattened, linear or linear-lanceolate to oblong-ovate.
            G. Leaf broad, obtuse, generally oblong, leaves occasionally opposite. (See also *Phyllocladus*, p.181, with broad, lobed, or toothed leaf-like cladodia) ..... AGATHIS, 245

GG. Leaf narrow, pointed, rarely obtusish, linear to lanceolate, rarely triangular-ovate.
H. Position of leaves more or less 2-ranked, usually with stomatic bands beneath.
I. Branchlets terminated by a distinct winter-bud with greenish scales.
J. Under surface of leaves with glaucous bands: branchlets opposite or subopposite.
K. Glaucous bands broader than the 3 green bands; leaves with raised midrib above..... CEPHALOTAXUS, 182
KK. Glaucous bands narrower than the 3 green bands; leaves without distinct midrib above, sharply pointed..... TORREYA, 183
JJ. Under surface of leaves pale or grayish-green: branchlets alternate .... TAXUS, 185
II. Branchlets not terminated by a distinct clearly defined winter-bud.
JJ. Shape of leaves linear, not exceeding 1 inch, distinctly 2-ranked.
K. Foliage persistent for several years, pungent, to 1 inch long: branchlets not deciduous..... SEQUOIA (*sempervirens*) 235
KK. Foliage deciduous together with the branchlets the second season; leaves to ½ inch long..... TAXODIUM (*mucronatum*) 234
JJ. Shape of leaves lanceolate, or oblong-lanceolate, usually longer than 1 inch, indistinctly 2-ranked.
K. Leaves finely serrulate, with distinct stomatic bands beneath, not more than ⅛ inch broad.. CUNNINGHAMIA, 240
KK. Leaves entire, without stomatic bands, about ⅛ inch broad..... ARAUCARIA (*Bidwillii*) 242
HH. Position of leaves not at all 2-ranked, without conspicuous stomatic bands beneath.
I. Leaves more or less imbricate, usually pungent.
J. Length of leaves up to ½ inch, with white stomatic bands above ..... ATHROTAXIS (*selaginoides*) 238
JJ. Length of leaves ½–1½ inches, without stomatic bands, at least ⅛ inch broad at base..... ARAUCARIA, 241
II. Leaves spreading, linear to linear-lanceolate.
J. Width of leaf less than $\frac{1}{12}$ inch, leaves sessile, ¼–¾ inch long, passing into scale-like leaves ..... WIDDRINGTONIA, 230
JJ. Width of leaf at least $\frac{1}{12}$ inch, leaves petioled, ½–4 inches long..... PODOCARPUS, 179

FF. All the leaves subulate, sometimes partly scale-like.
G. Base of leaves quadrangular or laterally flattened, usually keeled above.
H. Branches in regular whorls, spreading, forming distinct tiers; lateral branchlets approximately in one plane..... ARAUCARIA, 241
HH. Branches more or less irregularly whorled; the lateral branchlets not in one plane.
I. Leaves stiff, pungent, strongly laterally compressed, passing into scale-like leaves on mature plants: branchlets pendulous on young plants..... TAIWANIA, 237
II. Leaves rather soft, not pungent, of one kind: branchlets not pendulous..... CRYPTOMERIA, 239
GG. Base of leaves flattened horizontally, concave or flat above, passing into scale-like leaves. SEQUOIA (*gigantea*) 236
EE. Winter-buds distinct, covered with imbricate scarious yellowish to blackish scales, often resinous: leaves articulate at base, not decurrent into a green leaf-cushion, linear or needle-like.
F. Branchlets smooth or nearly smooth after fall of leaves which leave a roundish scar: leaves with stomatic bands only beneath or stomatiferous on both sides.
G. Upper surface of leaves with raised midrib, flat: winter-buds small, not resinous..... KETELEERIA, 246
GG. Upper surface of leaves grooved or flat, or these sometimes quadrangular.
H. Leaf-scars not raised: winter-buds short, ovoid, and usually resinous (in one species elongated and leaves spiny-pointed, 1½–2½ inches long)..... ABIES, 248
HH. Leaf-scars slightly raised at lower end: winter-buds elongated, pointed, not resinous ..... PSEUDOTSUGA, 263
FF. Branchlets roughened after fall of leaves by the stalk-like processes of the leaf-cushions which are separated by incised grooves.
G. Leaf quadrangular or flattened and with stomatic lines on all sides or only above, often spiny-pointed, with 2 or more lateral resin-ducts..... PICEA, 269
GG. Leaf flattened and with stomatic bands beneath, sometimes convex above and with stomatic lines above and beneath, never spiny-pointed, with one resin-duct under the midrib..... TSUGA, 265
DD. Form of leaves scale-like or sometimes scale-like and linear on the same plant.
E. Branchlets terete or angled.
F. Leaf not or obtusely keeled.

GG. Apex of leaves obtusish, slightly incurved, their form triangular-ovate to oblong ... ATHROTAXIS, 238
GG. Apex of leaves not or scarcely incurved, acutely mucronate or acuminate ..... SEQUOIA (*gigantea*), 236
FF. Leaf with prominent decurrent keel on back, incurved, with minutely serrulate margin. TAIWANIA, 237
EE. Branchlets flattened into broad leaf-like cladodia with minute scale-like leaves on the margin. PHYLLOCLADUS, 181
CC. Arrangement of leaves clustered or whorled, at least partly so.
D. Form of leaves flat, deeply furrowed on both sides, 3–6 inches long, in whorls of 15–35 at end of branchlets..... SCIADOPITYS, 232
DD. Form of leaves needle-shaped, angled.
E. The leaves in fascicles of 2–5, rarely to 8 or solitary, surrounded at base by a sheath of scarious scales..... PINUS, 295
EE. The leaves many, clustered on short spurs .... CEDRUS, 293
BB. Leaves opposite or whorled.
C. Arrangement of leaves opposite.
D. Form of leaves linear to oblong-ovate.
E. Shape of leaves broad, oblong-lanceolate to oblong-ovate, rarely ovate, more or less 2-ranked.
F. Leaf obtuse, oblong or oblong-lanceolate..... AGATHIS, 245
FF. Leaf acuminate, ovate-oblong to ovate or elliptic-ovate..... PODOCARPUS (*Nagi*) 181
EE. Shape of leaves linear, decussate.
F. Leaf obtuse to acutish, usually with glaucescent or grayish bands beneath (juvenile forms of genera of Cupressineæ).
G. Texture of leaves rather soft.
H. Foliage light bluish-green or almost silvery-white, very soft, violet in winter: branchlets spreading..... *Chamæcyparis pisifera* var. *squarrosa*, 215
HH. Foliage bright or dull green: branchlets more or less upright.
I. Upper surface of leaves bright green or slightly glaucescent, with bluish bands beneath, coloring violet or brownish-red in winter..... *Chamæcyparis thyoides* var. *ericoides*, 213
II. Upper surface of leaves dull green, grayish-green beneath, changing to brownish-green in winter..... *Thuja occidentalis* var. *ericoides*, 225
GG. Texture of leaves rather rigid, about 1/6 inch long: compact roundish shrubs (see also *Cupressus macrocarpa* var. *Crippsii*, p. 209).
H. Leaves obtuse, bluish-gray..... *Chamæcyparis obtusa* var. *ericoides*, 216
HH. Leaves acute, bright or bluish-green.... *Thuja orientalis* var. *decussata*, 227
FF. Leaf acute, with 2 glaucescent or whitish lines above, green beneath..... JUNIPERUS, 194
DD. Form of leaves scale-like.

E. Branchlets terete or quadrangular.
F. Leaves of vigorous branches not distinctly decussate and often only subopposite ..... WIDDRINGTONIA, 230
FF. Leaves always distinctly opposite and decussate.
G. Margin of leaves entire or sometimes fringed; leaves occasionally ternate..... JUNIPERUS, 194
GG. Margin of leaves minutely fringed or denticulate; leaves always opposite..... CUPRESSUS, 207
EE. Branchlets flattened (rarely quadrangular in Chamæcyparis and leaves with entire margin).
F. Width of branchlets $\frac{1}{16}$ inch or less.
G. Margin of leaves fringed..... CUPRESSUS, 207
GG. Margin of leaves entire.
H. Internodes longer than broad; branchlets bright green on both sides..... LIBOCEDRUS, 220
HH. Internodes of short branchlets about as long as broad; branchlets often with whitish markings beneath.
I. Branchlet-systems usually not distinctly frond-like; branchlets less than $\frac{1}{12}$ inch broad..... CHAMÆCYPARIS, 211
II. Branchlet-systems distinctly frond-like; branchlets $\frac{1}{12}$-$\frac{1}{8}$ inch broad, much flattened..... THUJA, 221
FF. Width of branchlets $\frac{1}{8}$-$\frac{1}{3}$ inch, with white markings beneath..... THUJOPSIS, 218
CC. Arrangement of leaves whorled (see also *Athrotaxis*, p. 238).
D. Number of leaves in whorl 3.
E. Form of leaves linear to lanceolate or oblong-ovate.
F. Shape of leaves oblong-ovate, incurved at apex, about $\frac{1}{8}$ inch long, with white bands beneath, green above..... FITZROYA, 227
FF. Shape of leaves linear to lanceolate, with white bands above, green beneath, usually rigid and spiny-pointed..... JUNIPERUS, 194
EE. Form of leaves scale-like.
F. Whorls of leaves close..... JUNIPERUS, 194
FF. Whorls of leaves, at least on leading shoot, remote; leaves minute..... CALLITRIS, 228
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AA. Plants with deciduous foliage.
B. Shape of leaves flabellate, 2–3 inches across at apex..... GINKGO, 177
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C. Leaves alternate and usually 2-ranked..... TAXODIUM, 233
CC. Leaves in clusters on short spurs.
D. Width of leaves $\frac{1}{12}$ inch or more, $1\frac{1}{2}$–3 inches long.. PSEUDOLARIX, 288
DD. Width of leaves narrower, not exceeding $1\frac{1}{2}$ inches long..... LARIX, 289

THE DESCRIPTIONS

In the following pages are described all the conifers, evergreen and deciduous, probably in cultivation in the continental United States and Canada. The distinguishing of these kinds or species is often difficult. One should have cones as well as leaves to make certain of identification. The descriptions are, of course, technical, for there is no other way of clearly separating the species and varieties. To identify the kinds accurately and with conviction is itself a satisfaction, comparable even with the rearing of the plants.

Fam. I. GINKGOACEÆ. GINKGO FAMILY

Deciduous resinous tree, without true vessels in the secondary wood: leaves fan-shaped, parallel-veined: flowers dioecious; the staminate flowers catkin-like, the anthers borne in stalked pairs on a slender axis; the fertile flowers long-stalked with usually 2 ovules; fertilization by motile sperm-cells: fruit drupe-like with a fleshy outer and a bony inner coat; embryo with 2 cotyledons. —One monotypic genus in eastern China. (Ginkgo is the Chinese name of the tree.)

GINKGO, L. MAIDENHAIR TREE

G. biloba, L. (*Salisburia adiantifolia*, Sm.). Fig. 22. Rather sparsely branched tree to 120 feet tall, glabrous: leaves alternate or in clusters of 3–5

22. Ginkgo biloba. Staminate flowers at *s;* pistillate at *p;* fruits, about one-half natural size, at *a.*

on spurs, slender-stalked, fan-shaped, more or less incised or divided at the broad summit, 2–3 inches across: fruit obovoid or ellipsoid, about 1 inch long, yellowish, consisting of a 2-angled, ovoid, creamy-white thin-shelled nut surrounded by a pulpy, ill-smelling outer coat; kernel sweet, edible. Eastern China, cultivated in Japan.—Introduced to Europe in 1730, to America in 1784. Hardy as far north as southern Canada. A rather sparingly branched, picturesque tree remarkable for its fan-shaped leaves which turn yellow in autumn; it is suitable for planting singly on the lawn and is also a desirable street tree, but the planting of fertile specimens should be avoided, as the ill-smelling fruits are objectionable.

Several horticultural forms are in cultivation, as var. **variegata,** Carr., with variegated leaves, var. **laciniata,** Carr., with deeply incised leaves, and var. **pendula,** Carr., with pendulous branches.

Fam. II. TAXACEÆ. YEW FAMILY

Much-branched evergreen trees or shrubs, with resin-tubes in the bark and no true vessels in the secondary wood: leaves alternate, rarely opposite, often 2-ranked, needle-like or scale-like, persistent: flowers dicœcious, rarely monœcious; staminate flowers cone-like, the anthers borne on the protected portion of more or less apically thickened or peltate scales (sporophylls); fertile flowers consisting of ovules borne singly or 2 together on a fleshy or rudimentary carpel (sporophyll), inverted or straight, the outer integument forming an arillus: fruit a dry seed with a bony shell, usually surrounded by a fleshy often highly colored aril, sometimes borne on a fleshy receptacle; embryo with 2 cotyledons.

The family is related to the Pinaceæ, but differs in the reduction of the pistillate cone to a single ovule, in the modification or suppression of the sporophyll, and in the aril or arillus. The closely related family of Ginkgoaceæ differs in the catkin-like staminate flowers with the anthers borne in stalked pairs on a slender axis, in the fertilization by means of motile sperm-cells and in the fan-shaped deciduous leaves. These three families were formerly united under Coniferæ and form, together with the Cycadaceæ and Gnetaceæ, the division of Gymnospermæ. Taxaceæ contains 12 genera and about 100 species, of which 60 belong to the genus Podocarpus, and is widely distributed in the temperate, subtropical, and tropical regions of both hemispheres. Its name is derived from the genus Taxus, the best and longest known genus of the family. Besides the five genera grown in this country and described below, the following are occasionally cultivated in Europe: Saxegothæa, Microcachrys, Acmopyle, and Dacrydium, a tropical genus with dimorphic, scale-like or needle-like foliage, while Pherosphæra, Amentotaxus, and Austrotaxus are apparently not in cultivation.

KEY TO THE GENERA

A. Anthers 2-celled: carpels 1-ovuled.
B. Seed without aril: leaves conspicuous, ¼–¾ inch broad .....1. PODOCARPUS
BB. Seed surrounded by an aril: leaves scale-like, but branchlets flattened and expanded into leaf-like cladodia .....2. PHYLLOCLADUS
AA. Anthers 3–8-celled: leaves linear, less than ¼ inch broad.
B. Female flower consisting of several pairs of 2-ovuled carpels: fruit drupe-like: leaves beneath with 2 glaucous bands broader than the 3 green bands: branchlets opposite....3. CEPHALOTAXUS
BB. Female flower reduced to a single ovule.
C. Fruit drupe-like: anthers 4-celled: leaves with 2 glaucous bands narrower than the 3 green lines, with aresin-duct in the middle: branchlets subopposite .....4. TORREYA
CC. Fruit berry-like, consisting of a bony seed surrounded by a campanulate aril: anthers 6–8-celled: leaves pale green beneath, without resin-duct: branchlets alternate.....5. TAXUS

1. PODOCARPUS, L'Hér.

Evergreen trees, rarely shrubs: leaves alternate, sometimes opposite or 2-ranked, sessile or short-stalked, linear to elliptic, entire, rarely scale-like: flowers monœcious or dicœcious, axillary or subterminal, solitary or in spikes at the end of short branchlets; the staminate flowers catkin-like, consisting of spirally disposed 2-celled anthers; the fertile flowers consisting of a scale inclosing the ovule, with several bracts at the base, which become usually much thickened at maturity, and form a fleshy receptacle bearing at the top the globular or ovoid drupe- or nut-like seed; cotyledons 2. (Name derived from the Greek *pous*, *podos*, foot, and *karpos*, fruit; in reference to the fleshy fruit-stalk of most species).—The genus contains about 60 species, chiefly in tropical and subtropical mountains of the West Indies, South America, Asia, Africa, and Australia. Some species with the flowers in spikes and the fruits without fleshy receptacle are separated by some botanists as Prumnopitys (Stachycarpus). Nageia is a synonym.

Two or three species are occasionally planted as ornamental trees in the Southern States, but more are cultivated in European collections. Many species are valuable timber trees in their native countries, and the fleshy seed-stalks of some are eaten.

A. Leaves linear-lanceolate, less than ½ inch broad, spirally arranged.
B. Length of leaves 1¾–4 inches, apex obtuse or acute .....1. *P. macrophylla*
BB. Length of leaves ½–1 inch, apex acute and pungent .....2. *P. Totara*
AA. Leaves elliptic-lanceolate to lanceolate or sometimes ovate, about ¾ inch broad.....3. *P. Nagi*

1. P. macrophylla, D. Don (*P. longifolia*, Hort.). LONGLEAF PODOCARP. Fig. 23. Tree attaining to 50 feet in height, with horizontally spreading

branches and pendent branchlets; the trunk with gray, shallowly fissured bark: leaves alternate, pinkish when unfolding, more or less spreading, narrowly lanceolate, narrowed toward the apex and acute or obtusish, at the base gradually narrowed into a short petiole, bright green and lustrous and with a distinct midrib above, paler below, 3–4 inches long and more than ⅓ inch broad: staminate flowers fascicled, sessile, about 1 inch long: seed ovoid, ⅓–½ inch long, borne on a fleshy purplish-violet receptacle. Japan.—Introduced to England by Wm. Kerr in 1804, to this country in 1862 by Dr. G. R. Hall. A tree of somber aspect, hardy as far north as South Carolina and perhaps farther.

23. Podocarpus macrophylla.

Var. **Maki**, Sieb. (*P. chinensis*, Wall. *P. macrophylla* var. *chinensis*, Maxim. *P. japonica*, Sieb.). Branches upright: leaves more upright, linear-lanceolate, obtuse or obtusish, 1¾–3 inches long and ⅛–¼ inch broad: seed globose-ovoid, ⅓ inch long or slightly longer. Japan. — Introduced to England about 1800. Tenderer than the type. Two variegated forms of this variety are in cultivation.

2. **P. Totara,** D. Don (*P. Totarra*, A. Cunn.). Tree to 80, or occasionally to 100 feet or more, tall; bark reddish-brown, fibrous, separating in long shreds, on old trees thick and deeply furrowed; branches spreading with distichous ramification: leaves spreading in two ranks, short-petioled, linear to linear-lanceolate, ½–1 inch long, acute and pungent, dull green above and plane or slightly grooved, paler beneath and with indistinct midrib: staminate catkins axillary, cylindric, ½–¾ inch long: fruit axillary, short-stalked, consisting of 1 or 2 subglobose seeds often slightly narrowed at the apex and about ½ inch long, with a red, swollen, rarely shriveled receptacle at the base. New Zealand.—Introduced to Great Britain about 1850. Cultivated in California.

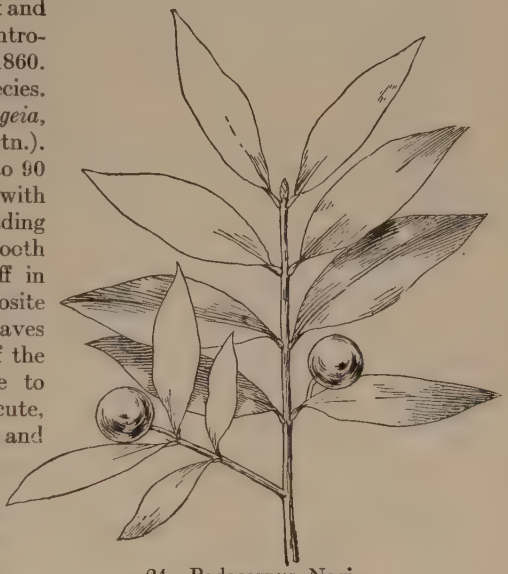
A species similar in foliage though belonging to a different group characterized by the staminate flowers being arranged in terminal spikes, by spike-like fertile flowers, and by the absence of a receptacle is **P. andinus,** Poepp.

PLATE XXXVII. Engelmann spruce (*Picea Engelmanni*), with inset of same as grown at Ottawa, Ontario

PLATE XXXVIII. Young pines (*Pinus densiflora; P. parviflora; P. echinata; P. Thunbergii*)

(*Prumnopitys elegans*, Phil.). A small tree or shrub: leaves crowded, slightly 2-ranked, linear, ½–¾ inch long, obtusish or mucronate, dark green and with a slightly raised midrib above, with a distinct midrib and 2 stomatiferous glaucous bands beneath: fruit subglobose, usually solitary on a slender drooping stalk, dark bluish-black and about ½ inch across. Chile.—Introduced to Great Britain about 1860. Hardier than the preceding species.

3. **P. Nagi**, Makino (*P. Nageia*, R. Br. *Nageia japonica*, Gaertn.). Nagi Podocarp, Fig. 24. Tree to 90 feet in its native country, with spreading or ascending-spreading branches; the trunk with smooth brownish-purple bark peeling off in thin gray flakes; branchlets opposite or sometimes alternate, green: leaves opposite, 2-ranked by a twist of the short petiole, elliptic-lanceolate to lanceolate, sometimes ovate, acute, narrowed at base, 2–3 inches long and about ¾ inch broad, many-nerved, bright green and usually lustrous above, slightly paler beneath, sometimes somewhat glaucescent: staminate flowers cylindric, about 1 inch long, in clusters of 3–5; fertile flowers solitary or in pairs: fruit globose, little over ½ inch across, plum-like, dark purple, bloomy, on a but slightly thickened peduncle. Southern Japan.—Introduced to Europe about 1830 by Siebold. Hardy only in southern California and Florida. A beautiful tree with its lustrous foliage and smooth broad leaves.



24. Podocarpus Nagi.

2. PHYLLOCLADUS, Rich.

Evergreen trees or shrubs; branches often whorled; branchlets flattened and expanded into rigid and coriaceous toothed or lobed leaf-like cladodia: true leaves reduced to linear scales: flowers monœcious or diœcious, the male flowers fascicled at the tips of the branchlets, the fertile flowers sessile on the margins of the cladodia or on peduncle-like divisions of the same: ovuliferous scales 1 or several and spirally arranged around an axis, thick and fleshy, free; aril coriaceous, as long as or shorter than the seed. (Name

derived from the Greek *phyllos*, leaf, and *klados*, branch, in reference to the leaf-like branchlets called phyllodia or cladodia.)

Six species, Malaysia to the Philippines and New Zealand. Besides the species described below, the following have been introduced into European gardens: *P. alpinus*, Hook. f., *P. glaucus*, Carr., and *P. trichomanoides*, D. Don, from New Zealand, and *P. hypophylla*, Hook. f., from Borneo.

P. rhomboidalis L. C. Rich. (*P. asplenifolius*, Hook. f.). Tree up to 60 feet, or shrub on mountain tops; persistent branches more or less reticulate, cladodia cuneate or rhomboidal: leaves very small, subulate: male catkins 2 or 3 together; female catkins globular, with 1, 2, or 3 fertile scales surmounted by 1 or 2 barren ones. Tasmania.—Introduced to Europe in 1825. A small tree or shrub of peculiar and distinct appearance, occasionally seen in California gardens and in eastern conservatories.

3. CEPHALOTAXUS, Sieb. & Zucc. PLUM-YEW

Evergreen trees or shrubs; branchlets opposite, with a resin-canal in the center of the pith: leaves linear, pointed, with a prominent midrib above and with 2 broad glaucous bands beneath, arranged in 2 rows, with a resin-duct in the middle: flowers dicœcious, staminate in 1–8-flowered, short-stalked clusters, fertile, consisting of a small cone with several bracts, each bearing 2 naked ovules: seed inclosed in a fleshy envelope, drupe-like, about 1 inch long, reddish- or greenish-brown. (Name derived from Greek *kephale*, head, and *Taxus*; a Taxus-like plant with the flowers in heads or clusters.)—Six species in Asia, from the Khasia Mountains to Japan.

25. Cephalotaxus drupacea.

Besides the two species here described, *C. Oliveri*, Mast., from China is occasionally cultivated in Europe; it is easily distinguished by its very closely set, rigid and spiny-pointed leaves truncate at base and about 1 inch long.

A. Leaves 1–2 inches long, abruptly pointed, in semi-erect ranks.....1. *C. drupacea*

AA. Leaves 2–3 inches long, gradually tapering into a fine point, nearly horizontally spreading.2. *C. Fortuni*

1. C. drupacea, Sieb. & Zucc. JAPANESE P. Fig. 25. Shrub or

small bushy tree, rarely to 30 feet tall in its native country, with wide-spreading branches usually light green when young; bark of trunk gray and fissured into narrow detachable strips: leaves about 1 inch long, abruptly pointed, narrow and straight, often upturned: staminate flowers very short-stalked: fruit usually obovate, narrowed at the base, purplish, about 1 inch long. Japan.—Introduced in 1830 to Europe by Siebold. Hardy in sheltered places as far north as Massachusetts and usually forming a shapeless, wide-spreading bush.

Var. **pedunculata,** Miq. (*C. Harringtonia,* C. Koch. *C. pedunculata,* Sieb. & Zucc.). HARRINGTON P. Young branches dark green: leaves to 2 inches long, narrowed into a sharp point: male flowers in branched heads on a stalk ½–¾ inch long.—Known only as a cultivated plant in Japan and introduced in 1829 into Europe.

Var. **fastigiata,** Pilger (*C. pedunculata* var. *fastigiata,* Carr. *Podocarpus koraiana,* Sieb. & Zucc.). SPIRAL P. Of columnar habit, with upright branches and spirally arranged leaves. Cultivated in Japan.—Introduced to Europe in 1830. Tenderer than the type and hardy as far north as New York.

Var. **nana,** Rehd. (*C. nana,* Nakai). DWARF P. Shrub with upright or ascending stems 1–6 feet tall and spreading by suckers: fruit subglobose, ¾ inch long, edible. North and central Japan.—Introduced in 1916 to the Arnold Arboretum by E. H. Wilson.

Var. **sinensis,** Rehd. & Wils. Shrub to 12 feet: leaves linear-lanceolate, tapering to a sharp point. Central and western China.—Introduced in 1907 to the Arnold Arboretum.

2. **C. Fortuni,** Hook. CHINESE P. Tree to 30 feet tall with slender, spreading branches often pendulous at the ends, the trunk usually dividing near the ground into 2 to 5 ascending stems with reddish-brown bark peeling off in large irregular flakes leaving pale markings: leaves 2–3 inches long, tapering gradually into a sharp point, usually falcate, dark green and shining above: fruit short-ellipsoidal, about 1¼ inches long, purplish. China.—Introduced to England in 1849 by Robert Fortune. Hardy as far north as New York and usually forming a rather irregular shrub with handsome dark green and lustrous foliage.

4. TORREYA, Arn. TORREYA

Evergreen trees with fissured bark, whorled branches, and subopposite branchlets; winter-buds with few decussate deciduous scales: leaves 2-ranked, linear or linear-lanceolate, spiny-pointed, without distinct midrib above and with 2 narrow glaucous bands beneath becoming fulvous with age, with a resin-duct in the middle; when bruised the foliage emits a pungent or fetid odor except in *T. grandis:* flowers dicœcious, rarely monœcious; staminate

flowers ovoid or oblong, composed of 6–8 whorls of stamens, surrounded at the base by bud-scales; fertile flowers consisting of a solitary ovule surrounded at the base by a fleshy aril and several scales: fruit drupe-like, consisting of a rather large seed, with thick woody shell entirely covered by a thin fleshy aril, ripening the second season; albumen ruminate; cotyledons 2, remaining under ground in germination. (The genus is named in honor of Dr. John Torrey, one of the most distinguished of early American botanists; 1796–1873.)—Four closely related species in North America and in eastern Asia; occasionally grown as ornamental evergreens for their handsome foliage and interesting habit.

A. Color of two-year-old branches yellowish-green or yellowish-brown.
  B. Leaves with scarcely impressed bands beneath, of fetid odor when bruised.....1. *T. taxifolia*
  BB. Leaves with strongly impressed bands beneath, scarcely fetid..2. *T. grandis*
AA. Color of two-year-old branches reddish-brown: leaves of aromatic-pungent odor when bruised.
  B. Leaves 1½–2½ inches long, linear.....3. *T. californica*
  BB. Leaves ¾–1¼ inches long, lanceolate,.....4. *T. nucifera*

1. T. taxifolia, Arn. (*Tumion taxifolium*, Greene). Florida T. (Stinking Cedar). Tree attaining 40 feet, with spreading slightly pendulous branches forming a rather open pyramidal head; bark brown, tinged orange: leaves linear, acuminate, rounded at base and subsessile, dark or dark yellowish-green above, with shallow white bands beneath, ¾–1½ inches long: fruit obovoid, dark purple, 1–1¼ inches long. Florida.—Discovered in 1833 and introduced into cultivation about 1840. Hardy at least as far north as South Carolina.

2. T. grandis, Fort. (*Tumion grande*, Greene). Tree occasionally to 80 feet high, sometimes shrubby: leaves linear-lanceolate, with a slender spiny point, ½–1¼ inches long and ⅛ inch broad, bright green and lustrous above, with 2 white impressed bands beneath: fruit obovoid-oblong, mucronate, measuring 1–1¼ inches long, brownish. Eastern China.—Introduced by Robert Fortune in 1855 to England. Hardy as far north as Massachusetts in sheltered positions.

3. T. californica, Torr. (*T. Myristica*, Hook. f. *Tumion californicum*, Greene). California-Nutmeg. Tree attaining 70 or occasionally 100 feet, with spreading, slightly pendulous branches, forming a pyramidal or, in old age, round-topped head; bark grayish-brown, tinged with orange: leaves linear, slightly falcate, acuminate, lustrous and dark green above, with narrow impressed bands beneath, 1–2½ inches long: fruit oblong-oval or oval, light green, streaked with purple, 1–1½ inches long. California.—Introduced to Europe in 1851. Hardy as far north as Philadelphia; a handsome tree with slender spreading branches, but usually shrubby in the East.

4. **T. nucifera,** Sieb. & Zucc. (*Tumion nuciferum*, Greene). JAPANESE T. Fig. 26. Tree usually 30 feet, but occasionally 80 feet high, with spreading branches, forming a compact head, sometimes shrubby; bark grayish-brown: leaves lanceolate, acuminate, rigid and spiny-pointed, very dark green above, with 2 white impressed bands beneath, ¾–1¼ inches long and ⅛–⅙ inch broad: fruit obovoid-oblong, about 1 inch long, green, faintly tinged and striped with purple. Southern and central Japan.—First introduced to England about 1764 and again by Siebold in 1831 to the Netherlands; to this country probably about 1860. A handsome tree with dark green lustrous leaves, hardy as far north as Massachusetts. The seeds are edible; the strong and close-grained wood is durable in water and is used in Japan for making water-pails and for cabinet-work.

26. Torreya nucifera.

5. TAXUS, L. YEW

Evergreen trees or shrubs with reddish or reddish-brown scaly bark; branchlets irregularly alternate; winter-buds with imbricate scales: leaves linear, pale or yellowish-green beneath, usually 2-ranked, without resin-ducts: flowers usually diœcious, solitary and axillary, rarely terminal, small, appearing in early spring; staminate flowers forming globose stalked heads, composed of 4–8 stamens each, with 3–8 anther-cells attached to the peltate connective; fertile flowers consisting of a single terminal ovule with several bracts at the base: seed a bony nut surrounded or almost inclosed by a fleshy cup-shaped scarlet disk, cotyledons 2, green. (Taxus is the ancient Latin name of the yew.)—The genus is distributed throughout the northern hemisphere; in America it extends to central Mexico and in Asia to the Philippines and the Malayan Archipelago. Eight species may be distinguished; they are all closely related and are often considered geographical varieties of a single species.

Apparently not in cultivation are *T. floridana*, Chapm., from Florida, *T. globosa*, Schlecht., from Mexico, and *T. Wallichiana*, Zucc., from the Himalayas and Malaysia. As an ornamental tree the yew is chiefly valued for its handsome dark green foliage and the attractive scarlet berries. The wood is heavy, hard, close-grained, strong, elastic, and of reddish color; it is highly valued for cabinet-making and turning. The foliage is poisonous to horses and cattle, but the berries are innocuous.

A. Scales of winter-buds obtuse, not keeled.
  B. Leaves gradually acuminate: bud-scales persistent ..... 1. *T. baccata*
  BB. Leaves abruptly pointed: bud-scales deciduous ..... 2. *T. chinensis*
AA. Scales of winter-buds acute or acutish, keeled, persistent: leaves abruptly pointed.
  B. Leaves $\frac{1}{12}$ to $\frac{1}{10}$ inch broad, with prominent midrib above ..... 3. *T. cuspidata*
  BB. Leaves $\frac{1}{12}$ inch or less broad, with slightly elevated midrib above.
    C. Seed broader than high: low shrub ..... 4. *T. canadensis*
    CC. Seed ovoid: small tree ..... 5. *T. brevifolia*

1. T. baccata, L. English Yew. Tree attaining 60 feet, with a usually short trunk, occasionally 8 feet or more in diameter; bark reddish, flaky, deeply fissured in old trees; branches spreading, forming a broad low head; branchlets usually remaining green the second year, somewhat pendulous: leaves 2-ranked, linear and usually falcate, shortly acuminate, with prominent midrib, dark green above, pale beneath, ¾–1¼ inches long or shorter in some varieties: fruit ⅓–½ inch across, ripening in September and October, the aril almost globose, about a third longer than the broadly ellipsoid brown seed and with an opening about as wide as the seed which is slightly compressed, slightly 2-, rarely 3–4-angled and ¼ inch long, with an oval hilum. Europe, northern Africa and western Asia.—Planted for ornament, particularly in English churchyards, since very early times and many venerable yews of great age are known in England. Hardy as far north as New York City and some forms in sheltered places as far north as Massachusetts. Many garden forms have originated in cultivation and the following are sometimes met with in American gardens:

Var. **lutea,** Endl. (var. *fructu luteo,* Hort., f. *luteo-baccata,* Pilger). Yellowberry Y. With yellow fruit, otherwise like the type. Discovered in 1817 in England, introduced into cultivation about 1838.

Var. **aurea,** Carr. (var. *elvastonensis aurea,* Beiss.). Golden English Y. Leaves golden-yellow, more brightly colored at the tips and margin. This form has proved hardier than the type in New England. Var. **Washingtoni,** Beiss. (var. *Washingtoni aurea,* Hort.). Washington Y. A form of wide-spreading habit with the leaves golden-yellow, particularly on the under side. Var. **elegantissima,** Beiss. (var. *aurea elegantissima,* Hort.). A vigorous form of dense and compact habit, occasionally more open, with the young leaves striped pale yellow, the older ones with whitish margin. Var. **semperaurea,** Dallimore (var. *erecta semperaurea,* Beiss.). A form of rather low growth, the leaves retaining their yellow color the second year. Var. **variegata,** West. (var. *argentea,* Loud.). Variegated English Y. Leaves with white or whitish variegation.

Var. **glauca,** Carr. A more vigorous form with ascending branches and with longer leaves bluish-green below, particularly when young.

Var. **procumbens,** Loud. PROSTRATE ENGLISH Y. Prostrate shrub, with elongated and much ramified branches. Var. **repandens,** Parsons. SPREADING ENGLISH Y. A low form with long wide-spreading branches and dull, bluish-green, narrower and longer leaves, partly falcately curved upward. Hardy in New England.

Var. **Jacksonii,** Gord. JACKSON Y. A form with spreading branches pendulous at the tips and with numerous short curved branchlets: leaves crowded, more or less incurved, rather broad, light green.

Var. **Dovastoni,** Laws. (var. *Dovastoni pendula*, Hort.). DOVASTON Y. Branches wide-spreading, nodding at the tips: leaves dull green, short and abruptly mucronulate. A very handsome form. Originated before 1800 in England. Var. **"Dovastoni aureo-variegata,"** Beiss. (var. *Dovastoni aurea*, Hort.). YELLOW DOVASTON Y. A form with the leaves variegated with yellow.

Var. **fastigiata,** Loud. (*T. hibernica*, Hort.). IRISH Y. Strictly fastigiate form, with stout crowded upright branches and branchlets: leaves radially arranged around the branches, dark glossy green, more obtuse than in the type. One of the most desirable evergreens of columnar habit for formal gardens. Discovered and introduced into cultivation about 1760 in England. Var. **"fastigiata variegata,"** Carr. (var. *argenteo-marginata*, Hort.). VARIEGATED IRISH Y. Less vigorous and more tender: leaves marked yellowish-white. Var. **"fastigiata aurea,"** Standish. GOLDEN IRISH Y. Young growth golden-yellow.

Var. **cheshuntensis,** Gord. CHESHUNT Y. A form resembling the Irish yew, with ascending branches: leaves radially spreading, narrower, dark green above, bluish-green below. Var. **erecta,** Loud. (var. *stricta*, Hort.). BROOM Y. Bushy form, with slender, upright branches and branchlets: leaves narrower and smaller than in the type, usually radially arranged.

Var. **adpressa,** Carr. (*T. parvifolia*, Wender. *T. brevifolia*, Hort., not Nutt. *T. tardiva*, Laws. *T. baccata tardiva*, Pilger). SHORTLEAF ENGLISH Y. Shrub or low tree of irregular habit, with long spreading branches: leaves oblong, obtusish, mucronulate, ⅓–½ inch long: disk of fruit shorter than the seed. Very distinct form which originated in England about 1828 or 1838 and is not of Japanese origin as sometimes stated. Var. **"adpressa erecta,"** Nichols. (var. *adpressa stricta*, Beiss.), has the foliage of the preceding, but erect branches forming a columnar bush.

2. **T. chinensis,** Rehd. (*T. cuspidata* var. *chinensis*, Rehd. & Wils. *T. baccata* var. *chinensis*, Pilger). CHINESE Y. Tree to 50 feet tall, with grayish or reddish bark; mature branchlets yellowish-green: leaves distinctly 2-ranked, horizontally spreading at nearly right angles from the stem, very short-stalked, usually falcate, the midrib slightly raised, dark green and lustrous above, grayish-green below, ¾–1¾ inches long: seed broadly ovoid,

slightly 2-angled and slightly compressed, with orbicular hilum. Central China.—Introduced in 1908 to the Arnold Arboretum. Hardy as far north as Massachusetts only in sheltered places. The plants in cultivation are yet too young to allow an opinion regarding the ornamental merits of this yew; its foliage is of lighter color than that of the following species; in its native country it produces fruit in great profusion.

27. Taxus cuspidata.

3. **T. cuspidata,** Sieb. & Zucc. (*T. baccata* var. *cuspidata,* Carr.). Japanese Y. Fig. 27. Plate IV. A tree with spreading or upright spreading branches, attaining a height of 50 feet; trunk with reddish-brown bark; branchlets usually brown the second year: leaves incompletely 2-ranked, the ranks more or less upright and forming a V-shaped trough, usually falcate, abruptly mucronate, abruptly contracted at base into a distinct yellowish stalk, dark and rather dull green above, with 2 broad tawny yellow or pale bands below, ¾–1 inch long, and about ⅛ inch broad, thickish; petiole abruptly enlarged into the leaf-cushion: fruit ripening in September and October, the aril with an opening narrower than the seed which is ovoid, compressed, slightly 3–4-angled, about ¼ inch long, with oval hilum. Japan, Korea, and Manchuria.—Introduced about 1855 to England by Fortune and into this country in 1862 by Dr. G. R. Hall. It is perfectly hardy as far north as Massachusetts and Ontario; it is the most vigorous of the yews and its dark green foliage retains its color through the winter. Var. *capitata,* Hort., does not differ from the typical plant.

Var. **aurescens,** Rehd. (*T. tardiva aurea,* Hort.). Low form with the leaves of the young branchlets deep yellow, changing later to green.

Var. **nana,** Rehd. (var. *brevifolia,* Hort. Amer. var. *compacta,* Bean). Dwarf Japanese Y. Plate X. Shrubby form with spreading branches densely clothed with short branchlets: leaves somewhat shorter and duller, ascending and not or scarcely 2-ranked: slow-growing, rather compact while young, but with age becoming more open.

Var. **densa,** Rehd. Low form making a dense sometimes almost hemi-

PLATE XXXIX. Golden-larch (*Pseudolarix amabilis*)

PLATE XL. An old cedar of Lebanon (*Cedrus libani*) near New York City

spherical bush with ascending branchlets: leaves like those of the preceding form.

A hybrid between *T. baccata* and *T. cuspidata* is **T. media,** Rehd. Intermediate between the parents, differing from *T. baccata* chiefly in the more vigorous habit, the olive-green branchlets often reddish above, in the slightly keeled scales of the winter-buds, in the broader and stouter, more abruptly acuminate leaves with prominent midrib above, and in the more abruptly enlarged base of the petiole, and from *T. cuspidata* in the olive-green color of the two-year-old branchlets, in the obtuse winter-buds with obtuse scales, in the more distinctly two-ranked leaves with often nearly horizontal ranks and more or less lustrous above. The hybrid was raised about twenty years ago in the Hunnewell gardens at Wellesley, Massachusetts, by T. D. Hatfield; the many seedlings combining the characters of the parents in various ways, but all differing from *T. baccata* in their greater hardiness. One distinct form is var. **Hatfieldii,** Rehd., a compact bush of conical shape with upright branches and radially spreading leaves; this form may take the place of the Irish yew where the latter is not hardy. Another similar hybrid, raised by Henry Hicks of Westbury, Long Island, is var. **Hicksii,** Rehd. (*T. cuspidata* var. *Hicksii,* Hort.), a distinctly columnar form with upright branches and radially spreading leaves, the original plant in the Hicks Nursery being now about 5 feet tall. This is even more similar to the Irish yew than the preceding variety and has proved perfectly hardy at the Arnold Arboretum where the Irish yew is too tender.

4. **T. canadensis,** Marsh. (*T. baccata* var. *minor,* Michx. *T. baccata* var. *canadensis,* Gray. *T. minor,* Britt.). Canada Y. Fig. 28. Low shrub usually diffuse and straggling, but occasionally ascending and up to 6 feet tall; mature branchlets green becoming reddish-brown: leaves often indistinctly 2-ranked, very short-stalked, narrow, abruptly mucronate, dark yellowish-green above, assuming a reddish tint in winter: flowers usually monœcious: fruit ripening in August, six to eight weeks earlier than those of *T. baccata* and *T. cuspidata,* the aril with an opening scarcely as wide as the seed which is broad-ovoid or broader than high, scarcely ridged, about $\frac{1}{5}$ inch long. Newfoundland and Manitoba to Virginia and Iowa.—Introduced to England about 1800. The hardiest of the yews, but less handsome than the other species, one of its chief drawbacks being the reddish tinge the foliage assumes in winter. It does well as undergrowth in shady woods,

28. Taxus canadensis.

where it forms a low diffuse shrub; in the open it becomes ascending and taller.

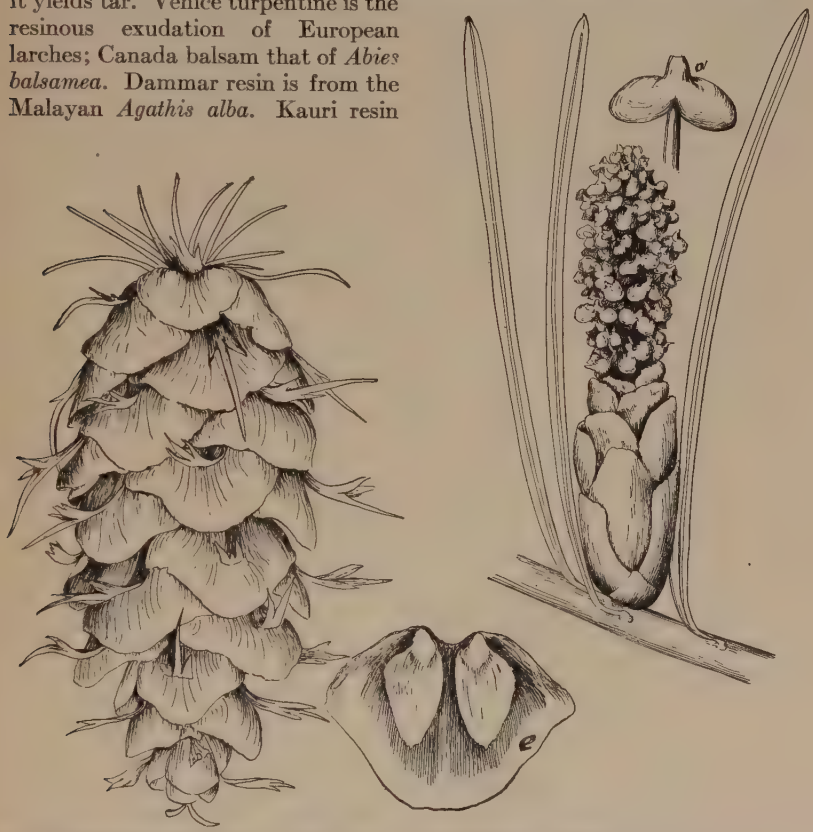
5. **T. brevifolia,** Nutt. (*T. baccata* var. *brevifolia,* Koehne). WESTERN Y. Tree 40–50 or occasionally 80 feet high, with slender horizontal or somewhat pendulous branches forming a broad, open, pyramidal head: leaves distinctly 2-ranked, sharply pointed, dark yellowish-green, ½–¾ inch long: fruit ripening in August and September; seeds ovoid, 2–4-angled. British Columbia to Montana and California.—Introduced in 1854 to England. In the eastern states it has as yet not been successfully grown, but plants recently introduced to the Arnold Arboretum from Montana will probably be hardy in Massachusetts.

Fam. III. PINACEÆ. PINE FAMILY

Resinous trees or shrubs without true vessels in the secondary wood, but with resin-tubes: leaves linear, or needle-like, or scale-like, alternate or opposite, evergreen or deciduous: flowers usually monœcious (dicœcious in Juniperus); anthers and ovules plainly subtended by scales (sporophylls) both in true cones; the staminate scales usually bearing 2–6, rarely more, anthers on the under side; the fertile flowers bearing 1–2, rarely many, ovules on the upper side, or peltate and ovule-bearing under the crown or at its base; ovules with 1 integument: fruit a dry woody cone with dry, often winged seeds between the scales; or (in Juniperus) berry-like through the union of the fleshy cone-scales; embryo with 2–15 cotyledons. (Fig. 29.)

The family contains 33 genera with more than 250 species widely distributed in both hemispheres, but most abundant in temperate regions. The genera described below are in cultivation in this country, while Fokienia, Diselma, Actinostrobus, and Glyptostrobus are occasionally but rarely grown in Europe; Callitropsis is probably not yet in cultivation. The name of the family is derived from the genus Pinus, the largest and most widely distributed genus. The family was formerly known as Coniferæ and included the Ginkgoaceæ and Taxaceæ, from which it differs in the presence of true staminate and pistillate cones. Like other Gymnosperms it is an old group, more abundant in former geologic ages. Many fossil species are known. The Sequoias of California were formerly more abundant, extending to Greenland. The young plants of many Cupressineæ possess foliage quite different in appearance from the mature foliage, the leaves being longer and more spreading. These juvenile forms have been called Retinisporas, a name originally applied to some Japanese species of Chamæcyparis. The leaves of Larix and Pseudolarix are deciduous. The branchlets and leaves are deciduous in Taxodium. The cone-scales of the Abietineæ are double, an outer thinner 3-toothed scale and a thick inner scale that bears the ovules.

Among the Pinaceæ are some of our most valuable timber trees; e. g., cedar, arbor-vitæ, spruce, fir, hemlock, and redwood. The resin from various pines when distilled yields spirits of turpentine and rosin; when dry-distilled, it yields tar. Venice turpentine is the resinous exudation of European larches; Canada balsam that of *Abies balsamea*. Dammar resin is from the Malayan *Agathis alba*. Kauri resin



29. Structure in Pinaceæ. Lower, cone of Pseudotsuga taxifolia, with the two seeds under a scale at *e*. Above, staminate cone of pine, with a separate stamen at *a*.

is the semi-fossilized resin of *Agathis australis* of Australia and New Zealand. Sandarac resin is from *Tetraclinis articulata* of northwestern Africa. Amber is the fossilized resin of prehistoric conifers around the Baltic. Oil of savin is from the leaves and twigs of *Juniperus Sabina*, and oil of cedar from *Thuja occidentalis*. Juniper berries, from *Juniperus*

communis of Europe and America, are diuretic and also used for flavoring gin. Edible seeds are produced by *Pinus Pinea* (stone pine) of the Mediterranean, *P. Cembra* of Europe and Siberia, *P. cembroides* of the southwestern United States, *Araucaria brasiliana* of Brazil, and *A. Bidwillii* of Australia. Bread is made by the Laps and Eskimos from the inner bark of *Pinus sylvestris;* also from various Pinaceæ by our northwestern Indians. The bark of the hemlock spruce is used for tanning.

KEY TO THE GENERA

A. Cone-scales and leaves opposite or whorled; ovules erect; cotyledons usually 2 ..... Subfam. I. CUPRESSINEÆ
  B. Fruit berry-like, indehiscent, consisting of 2–6 connate fleshy scales inclosing 1–12 seeds: leaves opposite or ternate, scale- or needle-shaped ..... 1. JUNIPERUS
  BB. Fruit a woody dehiscent cone.
    C. Leaves opposite and scale-like (only in the juvenile state needle-shaped): cone-scales peltate or imbricate, opposite.
      D. Scales of cone peltate; cone subglobose.
        E. Each cone-scale with many seeds; cone rather large, usually ripening the second year: branchlets terete or quadrangular, rarely flattened, usually irregularly spreading: leaves fimbriate ..... 2. CUPRESSUS
        EE. Each cone-scale with 1–5 seeds; cone small, ripening the first season: leaves with entire margin: branchlets flattened, rarely 4-sided, usually 2-ranked in one horizontal plane ..... 3. CHAMÆCYPARIS
      DD. Scales of cone flattened, imbricate: branchlets flattened.
        E. Each cone-scale with 3–5 seeds: branchlets much flattened, $\frac{1}{6}$–$\frac{1}{3}$ inch broad ..... 4. THUJOPSIS
        EE. Each cone-scale with 1–5 seeds: branchlets narrower.
          F. Number of cone-scales 4 or 6, the upper pair fertile ..... 5. LIBOCEDRUS
          FF. Number of cone-scales 8–12, the 2 upper pairs fertile ..... 6. THUJA
    CC. Leaves usually whorled, scale-like or linear: cone-scales valvate, opposite or whorled.
      D. Cone with the lower scales sterile and slightly imbricate: leaves ternate ..... 7. FITZROYA
      DD. Cone with all the scales fertile and distinctly valvate.
        E. Number of cone-scales 6–8, unequal: leaves in whorls of 3 or 4 ..... 8. CALLITRIS
        EE. Number of cone-scales 4, equal or nearly equal.
          F. Branchlets compressed, articulate: leaves in whorls of 4 ..... 9. TETRACLINIS
          FF. Branchlets terete: leaves opposite or on leading shoots alternate ..... 10. WIDDRINGTONIA

AA. Cone-scales and leaves spirally arranged, the latter sometimes fascicled; ovules inverted, rarely upright.
B. Scales of cone without distinct bracts, flat or peltate, with 1–9 seeds.
C. Carpels with 2–9 ovules, more or less divided into scale and bract, coalescing and connate at maturity; cotyledons 2–9 ..... Subfam. II. TAXODINEÆ
D. Leaves dimorphic, partly scale-like and scattered, partly linear and connate into whorled pairs: cone-scales thick and woody, imbricate ..... 11. SCIADOPITYS
DD. Leaves never connate, homomorphic or heteromorphic, always scattered.
E. Form of cone-scales peltate: leaves heteromorphic.
F. Scales with 2 upright seeds: staminate flowers paniculate: branchlets deciduous the first or second year ..... 12. TAXODIUM
FF. Scales with 5–7 pendulous seeds: staminate flowers spicate: branchlets persistent for several years ..... 13. SEQUOIA
EE. Form of cone-scales flattened, imbricate.
F. Seeds of each scale 2, pendulous: leaves heteromorphic ..... 14. TAIWANIA
FF. Seeds of each scale 3–7: leaves homomorphic.
G. Staminate flowers solitary: scales with 3–6 pendulous seeds: leaves scale-like or lanceolate and short ..... 15. ATHROTAXIS
GG. Staminate flowers spicate or umbellate.
H. Arrangement of staminate flowers spicate: scales with 4–5 erect seeds: leaves awl-shaped ..... 16. CRYPTOMERIA
HH. Arrangement of staminate flowers umbellate: scales with 3 pendulous seeds: leaves lanceolate, flat, 1–2 in. long .... 17. CUNNINGHAMIA
CC. Carpels simple, with 1 inverted ovule; cones large; cotyledons 2–4 ..... Subfam. III. ARAUCARINEÆ
D. Seed adnate to the scale at base: leaves 4-angled or flat and broad at base, crowded, not or indistinctly 2-ranked ..... 18. ARAUCARIA
DD. Seed free: leaves on lateral branches 2-ranked, large and flat, more or less distant, narrowed at base ..... 19. AGATHIS
BB. Scales of cone subtended by distinct bracts; scales with 2 inverted ovules; seeds winged, rarely wingless: leaves linear or needle-shaped: winter-buds distinct with scarious scales ..... Subfam. IV. ABIETINEÆ
C. Arrangement of leaves solitary.
D. Cones upright.
E. Cone-scales persistent; bracts much shorter; seeds about as long as scales: leaves flattened, keeled above ..... 20. KETELEERIA

EE. Cone-scales deciduous from their axis; bracts often exserted; seeds shorter than scales: leaves flattened and grooved above or rarely 4-angled.....21. ABIES

DD. Cones reflexed or pendulous; scales persistent.

E. Bracts exserted, conspicuous: branchlets not roughened by leaf-bases; leaves flat.....22. PSEUDOTSUGA

EE. Bracts not exserted: branchlets roughened by persistent leaf-bases.

F. Leaves usually flat, with bands of stomata on the dorsal side, or sometimes convex or keeled above and with stomata on both sides, never sharply pointed; with one resin-duct in the middle under the vascular bundle.....23. TSUGA

FF. Leaves usually 4-sided and nearly equally stomatiferous on all sides, or flattened and with more numerous rows of stomata on the ventral side than on the dorsal side or without any stomata on the dorsal side, usually more or less pointed; with 2 or more lateral resin-ducts.....24. PICEA

CC. Arrangement of leaves in fascicles or clusters, solitary only on shoots.

D. Leaves many, clustered on short, thick spurs.

E. Staminate flowers clustered; cone-scales deciduous: leaves deciduous.....25. PSEUDOLARIX

EE. Staminate flowers solitary.

F. Cone-scales persistent; cone ripening the first year, small: leaves deciduous.....26. LARIX

FF. Cone-scales finally deciduous; cone large, ripening the second or third season: leaves persistent.....27. CEDRUS

D. Leaves in fascicles from 2–5, rarely to 8, or reduced to 1, sheathed at base by scarious bud-scales: cone with persistent scales.....28. PINUS

1. JUNIPERUS, L. JUNIPER

Evergreen trees or shrubs, with the branchlets spreading in all directions: leaves either all needle-shaped and in 3's, or needle-shaped and scale-like, and usually opposite, both kinds often found on the same plant, the needle-shaped leaves prevailing on younger plants and vigorous branches, the scale-like ones on older plants: flowers diœcious, rarely monœcious; staminate yellow, consisting of numerous anthers united into an ovoid or oblong catkin; fertile flowers greenish, minutely globular, with several bracts, each or some bearing 1 or 2 ovules; the bracts become fleshy and unite into a berry-like cone, usually wholly inclosing the 1–6, rarely 12, seeds. The fruit ripens either the first year, as in *J. virginiana*, or the second, as in *J. Sabina* and

most species, or in the third, as in *J. communis.* (Juniperus is the ancient Latin name of the genus.)—The genus contains about 40 species distributed chiefly throughout the extra-tropical regions of the northern hemisphere, in America south to Mexico and the West Indies, and in Africa south to the mountains of eastern Africa.

Juniperus is closely allied to Cupressus, and sometimes hard to distinguish without fruit; but young plants with needle-shaped leaves can almost always be told apart, since Juniperus has whitish bands or marks on the upper surface of the leaves, while the similar juvenile forms of allied genera have the whitish marks beneath. Most species are very variable, as well in habit as in the shape of the leaves, which renders the determination of an unknown form, at least without fruit, a rather difficult task.

The close-grained fragrant wood of the tree-like species is used for the interior finish of houses and in the manufacture of small articles, as it is very durable in the soil; that of *J. virginiana* and *J. lucayana* is in great demand for pencil-making. The fruit and also the young branchlets of some species contain an aromatic oil used in medicine. The fruit of *J. drupacea* is edible.

AA. Leaves jointed at base, needle-shaped, in 3's, not glandular: winter-buds distinct, scaly: staminate flowers axillary.
B. Fruit large, ¾–1 inch across; seeds connate into a usually 3-celled stone: leaves ⅛–⅙ inch broad..... 1. *J. drupacea*
BB. Fruit smaller; seeds not connate: leaves narrower.
C. Upper surface of leaves with 2 white bands: fruit brown or orange.
D. White bands of leaves scarcely as broad as green margin..... 2. *J. macrocarpa*
DD. White bands broader than the green margin: branchlets slender and pendulous..... 3. *J. formosana*
CC. Upper surface of leaves with 1 white band.
D. Shape of leaves narrow-linear, sulcate above, keeled below, stiff.
E. Habit upright; branches ascending or spreading, pendulous at the tips..... 4. *J. rigida*
EE. Habit prostrate..... 5. *J. conferta*
DD. Shape of leaves linear to lanceolate, concave above with broad white band, obscurely keeled below.. 6. *J. communis*
AA. Leaves decurrent, not jointed at base, opposite or in 3's, scale-like or needle-shaped, usually with a gland on back: without distinct winter-buds: staminate flowers terminal.
B. Form of leaves needle-shaped, always in 3's, with 2 white bands above, loosely appressed. (See also *J. chinensis japonica.*)
C. Branchlets green: leaves green or glaucescent beneath: fruit ellipsoidal, 1-seeded..... 7. *J. squamata*
CC. Branchlets with glaucous bands along the edges of the pulvini, decurrent from a whitish spot at each side of the base of the leaves: fruit subglobose, 2–3-seeded..... 8. *J. procumbens*

BB. Form of leaves scale-like or of two kinds (all needle-shaped in vars. of No. 15).
C. Margin of leaves minutely denticulate or fringed (under a strong lens).
D. Fruit reddish-brown.
E. Bark scaly: scale-like leaves obtusish, apiculate, opposite: fruit 3–4-seeded ..... 9. *J. pachyphlœa*
EE. Bark shreddy: scale-like leaves acute or acuminate, opposite or ternate: fruit 1-seeded ....10. *J. utahensis*
DD. Fruit blue or blue-black.
E. Scale-like leaves usually ternate, conspicuously glandular: fruit 2–3-seeded .....11. *J. occidentalis*
EE. Scale-like leaves opposite, rarely ternate, glandless: fruit usually 1-seeded .....12. *J. monosperma*
CC. Margin of leaves entire.
D. Color of fruit brown or purplish-brown.
E. Scale-like leaves acute; acicular leaves opposite (except on leading shoots).
F. Seeds of fruit 3–6: leaves ovate. .....13. *J. excelsa*
FF. Seeds of fruit 2–3: leaves lanceolate .....14. *J. procera*
EE. Scale-like leaves obtuse; acicular leaves often ternate: fruit brown, bloomy, 2–3-seeded.....15. *J. chinensis*
DD. Color of fruit bluish, bloomy.
E. Plant usually a tree: fruit on erect pedicels.
F. Branchlets stout and short, thickly set: acicular leaves rigid and spiny-pointed.....16. *J. bermudiana*
FF. Branchlets slender.
G. Fruit ripening the first season.
H. Diameter of fruit $\frac{1}{12}$–$\frac{1}{6}$ inch: leaves acute: branchlets very slender, usually pendulous: southern tender tree.....17. *J. lucayana*
HH. Diameter of fruit $\frac{1}{4}$–$\frac{1}{3}$ inch: leaves acute or acuminate: branchlets usually upright or spreading: northern tree.....18. *J. virginiana*
GG. Fruit ripening the second season, $\frac{1}{4}$–$\frac{1}{3}$ inch across.....19. *J. scopulorum*
EE. Plant a shrub: fruit on curved pedicels, pendulous.
F. Leaves bluish-green or steel-blue, acute, of slight aromatic odor: prostrate shrub.....20. *J. horizontalis*
FF. Leaves dark or bluish-green, acutish or obtuse, of disagreeable odor when bruised: shrub with usually ascending or spreading branches...21. *J. Sabina*

Section I. Caryocedrus, Endl.

Leaves ternate, all needle-shaped, jointed at base, not glandular: winter-buds distinct, scaly: flowers diœcious, axillary: fruit large, $\frac{3}{4}$–1 inch across; seeds connate into a 3-celled stone.

1. **J. drupacea,** Labill. Syrian J. Pyramidal tree with narrow head, to

45 feet; branchlets triangular, with prominent ridges: leaves decurrent, linear-lanceolate, spiny-pointed, ½–¾ inch long and ⅛–1/16 inch broad (the broadest of all species), with 2 white lines above and broad green midrib, keeled below: fruit bluish-black or brown, bloomy, ¾–1 inch across, edible. Greece, Asia Minor.—Introduced in 1854 to England. Handsome ornamental tree of columnar habit; thrives in limestone soil. Probably not hardy north of the Middle Atlantic States.

Section II. Oxycedrus, Endl.

Leaves, winter-buds, and flowers like those of the preceding section: fruit smaller; seeds free, usually 3.

2. **J. macrocarpa,** Sibth. (*J. neaboriensis*, Gord.). Plum J. Shrub or small tree, to 12 feet high, of dense pyramidal habit: leaves crowded, linear-lanceolate, tapering from the base, spiny-pointed, spreading, ½–¾ inch long and about 1/12 inch broad: fruit to ½ inch across, dark brown, glaucous. Mediterranean region.—Introduced into cultivation in 1838; probably hardy as far north as New York.

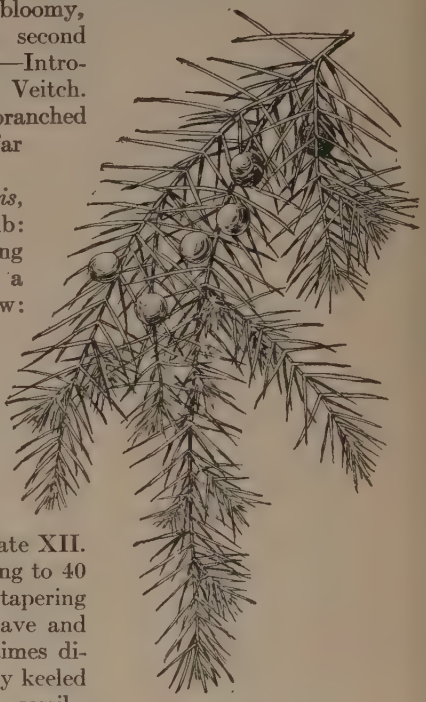
Related species are the following: **J. Oxycedrus,** L. Prickly J. Shrub or tree to 30 feet, with slender branches: leaves linear, tapering from the middle to a spiny point, 1/24–1/16 inch wide: fruit ¼–½ inch across, not or only partially glaucous. Mediterranean region to Caucasus and Persia. Introduced to England before the beginning of last century.—**J. Cedrus,** Webb & Berth. (*J. pendula*, Loud.). Tree with wide-spreading branches and pendulous branchlets: leaves less rigid, scarcely spiny: fruit subglobose, ⅓–½ inch long, finally orange-brown. Canary Islands.—Cultivated in California.

3. **J. formosana,** Hayata (*J. taxifolia*, Parl., not Hook. & Arn.). Formosa J. Tree to 40 feet usually dividing into several stems from the base, with spreading or ascending branches and pendulous branchlets: leaves more or less directed forward, linear, spiny-pointed, ½–1 inch long and 1/16–1/12 inch wide, with 2 broad white bands above, confluent near apex, keeled below: fruit subglobose to broadly ovoid, about ⅓ inch across, reddish or orange-brown. Formosa, China.—Introduced by Fortune to England about 1850, and in 1907 by E. H. Wilson to this country. Handsome tree with pendulous branchlets, hardy as far north as Massachusetts.

A related species is **J. taxifolia,** Hook. & Arn., which is easily distinguished by the obtuse or obtusish leaves ¼–½ in. long ,and the lustrous, light chestnut-brown, subglobose or depressed-globose fruit. Bonin Islands. —Introduced in 1917 by E. H. Wilson to the Arnold Arboretum; probably hardy only in the Southern States and California.

4. **J. rigida,** Sieb. & Zucc. Needle J. Fig. 30. Small pyramidal tree, to 30 feet, or spreading shrub with the slender branches pendulous at the

extremities: leaves in closely set whorls, narrow-linear, tapering from the middle into a spiny point, stiff, sulcate and with a narrow white band above, prominently keeled below, yellowish-green, ½–1 inch long: fruit globose, ¼–⅓ inch across, brownish-black, bloomy, finally somewhat shining, ripening the second year. Japan, Korea, and Manchuria.—Introduced in 1861 to England by J. G. Veitch. Graceful, narrow-pyramidal tree, loosely branched with pendulous branchlets; hardy as far north as New England and Ontario.



30. Juniperus rigida.

5. **J. conferta,** Parl. (*J. litoralis,* Maxim.). Shore J. Procumbent shrub: leaves crowded, narrow-linear, tapering into a spiny point, sulcate and with a narrow white band above, keeled below: fruit globose, ¼–½ inch across, bloomy black at maturity, 3-seeded. Japan and Saghalin, on sandy seashores.—Introduced in 1915 to the Arnold Arboretum by E. H. Wilson. Hardy at least as far north as Massachusetts; it should make a good ground-cover and be particularly suited for planting on sand-dunes.

6. **J. communis,** L. Common J. Plate XII. Upright shrub or tree, sometimes attaining to 40 feet: leaves linear or linear-lanceolate, tapering from the base into a sharp point, concave and with a broad white band above, sometimes divided at base by a green midrib, bluntly keeled below, ½–¾ inch long: fruit almost sessile, dark blue, glaucous, ¼–⅓ inch across, ripening the second or third year. The typical form is common in northern and central Europe and extends through northern and western Asia to Korea and Japan; in North America it occurs only occasionally from New England to Pennsylvania and North Carolina.—A variable species with several geographical and climatic varieties and some garden forms.

Var. **aurea,** Carr. (var. *aureo-variegata,* Beiss. var. *variegata aurea,* Carr.). Golden J. Young growth golden-yellow turning green the second year.

Var. **suecica,** Loud. (var. *fastigiata,* Hort.). Swedish J. Narrow columnar form, growing sometimes into a tree to 40 feet high, with rather long, spreading leaves, the branchlets with drooping tips: of lighter and more bluish color than the following variety. Var. **hibernica,** Gord. (var. *stricta,*

Carr.). Irish J. Narrow columnar form, with upright branches, deep green, tips of branchlets erect: leaves shorter, less spreading.

Var. **pendula**, Carr. Shrub with spreading, recurving branches and pendulous branchlets. Var. **oblongo-pendula,** Carr. (var. *reflexa*, Parl., not *J. oblonga pendula*, Knight). An upright shrub of broadly columnar outline with pendulous branchlets. A very graceful form.

Var. **depressa,** Pursh (*J. communis* var. *canadensis*, Loud. *J. canadensis*, Burgsd. *J. nana canadensis*, Carr.). Prostrate J. Forming broad patches, the stems ascending from a procumbent base, rarely exceeding 4 feet in height. The leaves somewhat shorter and broader. A form of this is var. **aureo-spica,** Rehd. (*J. nana canadensis aurea*, Beiss. *J. canadensis aurea*, Hort.). Tips of branchlets golden-yellow.

Var. **montana,** Ait. (*J. communis nana*, Loud. *J. nana*, Willd. *J. alpina*, S. F. Gray. *J. sibirica*, Burgsd.). Mountain J. Low, spreading or procumbent shrub, seldom over 2 feet high: leaves oblong-linear, abruptly pointed, usually incurved, densely clothing the branches, with a broad silvery-white line above, ¼–½ inch long. Arctic and mountainous regions.

Var. **Jackii,** Rehd. Prostrate, with flagelliform trailing branches often to 3 feet long, and almost unbranched except for occasional clusters of short lateral branchlets 1–2 inches long: leaves linear-lanceolate, incurved. Oregon, northern California.—Introduced in 1904 to the Arnold Arboretum.

Var. **nipponica,** Wils. (*J. nipponica*, Maxim.). Similar to the preceding, but leaves deeply sulcate above and keeled below. High mountains of Japan. —Introduced in 1915 to the Arnold Arboretum by E. H. Wilson.

Section III. Sabina, Endl.

Leaves opposite or ternate, decurrent, not jointed, usually with a gland on back, scale-like or partly needle-shaped, rarely all needle-shaped and ternate; winter-buds indistinct, naked: flowers monœcious or sometimes dioecious, terminal: seeds 1–6, free.

7. **J. squamata,** Lamb. (*J. recurva* var. *squamata*, Parl. *J. recurva* var. *densa*, Hort.). Decumbent shrub, sometimes ascending; branchlets thick, ascending at the apex, green: leaves crowded, loosely appressed, linear-lanceolate or lanceolate, straight or slightly curved, finely pointed, grayish- or bluish-green, with 2 grayish-white bands above, convex below and grooved from the base to near apex, ⅙–¼ inch long: fruit changing from reddish-brown to purplish-black, globose-ovoid, ¼–⅓ inch long. Himalayas, western China, and Formosa.

Var. **Fargesii,** Rehd. & Wils. Tree to 70 feet: leaves longer and narrower, linear-lanceolate, more spreading, usually about ⅓ inch long, acuminate: fruit ovoid, ¼ inch long.

Var. **Wilsonii,** Rehd. WILSON J. Upright shrub to 6 feet, densely clothed with short branchlets recurved at the tips: leaves shorter and broader, crowded, broadly lanceolate, about 1/6 inch long. Western China.—Introduced to the Arnold Arboretum by E. H. Wilson in 1909.

Var. **Meyeri,** Rehd. MEYER J. Upright shrub much branched with short, straight branchlets: leaves narrow-lanceolate, straight, 1/4–1/3 inch long, very glaucous on back. China.—Introduced in 1914 by F. N. Meyer through the Department of Agriculture. Very handsome on account of its dense habit and the bluish-white color of its foliage.

A closely related species is **J. recurva,** Ham. A small tree to 30 feet tall, with spreading, curved branches and pendulous branchlets: leaves very concave above, grooved beneath below the middle: fruit ovoid, 1/3–1/2 inch long. Himalayas.—Introduced about 1830 to Great Britain. A graceful tree, hardy probably only in the Southern States.

8. **J. procumbens,** Sieb. (*J. chinensis* var. *procumbens,* Endl.). Low spreading shrub with stiff ascending branchlets, about 2 feet high: leaves in 3's, linear-lanceolate, spiny-pointed, concave above and glaucous with a green midrib toward the apex, below bluish with 2 white spots near the base from which 2 glaucous lines run down the edges of the pulvini, 1/4–1/3 inch long: fruit subglobose, 2–3-seeded, about 3/8 inch across.—Cultivated in Japan and introduced in 1843 to Europe and in 1862 to America. Hardy as far north as Massachusetts; sometimes planted as ground-cover, particularly in California.

9. **J. pachyphlœa,** Torr. (*Sabina pachyphlœa,* Ant.). ALLIGATOR J. Tree to 60 feet tall, with a short trunk and stout spreading branches forming a broad-pyramidal or round-topped head; bark dark brown, thick, broken into small, closely appressed scales; branchlets slender: leaves usually scale-like, opposite, rhombic-ovate, rounded or apiculate at apex, obscurely keeled on back and glandular, bluish-green, 1/16 inch long: fruit globose or broadly ellipsoidal, tuberculate, reddish-brown, bloomy, about 1/2 inch long, with 3–4 seeds. Arizona and New Mexico to southwestern Texas and Mexico.—Introduced to Europe before 1875. One of the handsomest of the American junipers, remarkable for its checkered bark; the acicular foliage of young plants is usually glaucous to nearly silvery-white. Not hardy north of the Middle Atlantic States.

10. **J. utahensis,** Lemm. (*J. californica* var. *utahensis,* Engelm. *Sabina utahensis,* Rydb.). UTAH J. Bushy tree, rarely exceeding 20 feet, with short trunk and erect to ascending branches forming a roundish open head; branchlets slender: leaves light yellow-green, usually scale-like and closely appressed, opposite or occasionally in 3's, rhombic-ovate, acute and often acuminate, rounded at back and usually glandless, about 1/12 inch long; acicular leaves usually in 3's: fruit subglobose or broadly ellipsoidal, 1/6–1/4 inch long, marked

by the tips of the scales, reddish-brown, bloomy, with thin sweet flesh, 1- or rarely 2–3-seeded. Wyoming to California, Arizona and New Mexico.—Rarely planted and of no particular ornamental value.

Var. **megalocarpa,** Sarg. (*J. megalocarpa*, Sudw.). Tree to 50 feet with a single trunk; the scale-like leaves in 3's: fruit ½–⅝ inch across. Arizona, New Mexico.—Introduced in 1916.

Related species rarely, if at all, in cultivation in this country are the following:

J. Pinchotii, Sudw. Shrubby tree to 20 feet tall; branchlets thick: leaves usually in 3's, obtusely pointed, rounded and conspicuously glandular-pitted on back, about $\frac{1}{16}$ inch long: fruit subglobose, ¼–⅓ inch long, reddish-brown, 1–2-seeded. Texas.—Introduced in 1917 to the Arnold Arboretum by E. J. Palmer.

J. californica, Carr. CALIFORNIAN J. Shrub or pyramidal tree to 40 feet tall; branchlets rather stout: leaves usually in 3's, obtusely pointed, conspicuously glandular-pitted and slightly keeled on bac : fruit ellipsoidal, ½–¾ inch long, reddish-brown, with thick sweet flesh. Southern California.—Introduced to Europe in 1853.

J. flaccida, Schlecht. A tree to 30 feet tall, with spreading branches and slender drooping branchlets: leaves opposite, acuminate, spreading at apex, glandular or eglandular on back: fruit subglobose, ⅓–½ inch across, dark red-brown, bloomy, with thick resinous flesh, 4–12-seeded. Southern Texas and northeastern Mexico.—Introduced to Europe about 1838. Hardy only in the Southern States.

J. phœnicea, L. PHŒNICIAN J. Shrub or small tree to 20 feet, with erect or ascending branches and slender, much ramified branchlets: scale-like leaves opposite or in 3's, obtuse or obtusish, rounded on back, dull dark or bluish-green: fruit subglobose, ⅓–⅖ inch across, 3–6-seeded. Mediterranean region.—Introduced to England about 1863. Probably hardy as far north as the Middle Atlantic States.

11. **J. occidentalis,** Hook. Tree to 40 feet, rarely to 60 feet tall, with spreading branches forming a broad, low head, or shrub with several upright stems; branchlets stout, about $\frac{1}{12}$ inch thick: leaves usually scale-like, in 3's, closely appressed, ovate, acute, grayish-green, conspicuously glandular on back, rarely acicular: fruit subglobose or ovoid, ¼–⅓ inch long, bluish-black, bloomy, 2–3-seeded. Washington and western Idaho to southern California.—Introduced to Europe about 1840.

12. **J. monosperma,** Sarg. (*J. occidentalis* var. *monosperma*, Engelm. *Sabina monosperma*, Rydb.). CHERRYSTONE J. A tree occasionally to 50 feet tall, with stout ascending branches or branching from the base and shrubby; branchlets slender, about $\frac{1}{24}$ inch thick: leaves mostly scale-like, opposite, rarely in 3's, acute or acuminate, often slightly spreading at apex, thickened

and rounded on back and conspicuously glandular, grayish-green; acicular leaves in 3's, often ½ inch long, inconspicuously glandular: fruit globose or ovoid, ⅛–¼ inch long, dark blue, bloomy, 1-seeded, rarely 2–3-seeded; the seeds sometimes exserted, pale chestnut-brown, obtuse and prominently ridged. Colorado to Nevada, western Texas and northern Mexico.—Introduced about 1900 to Germany. Of little ornamental value and probably not hardy north of the Middle Atlantic States.

A related species is **J. mexicana,** Schlecht. (*J. sabinoides*, Nees. *J. tetragona*, Schlecht.). Tree to 30 or occasionally to 100 feet tall: leaves obtuse or acute, thickened and keeled on back, usually eglandular: fruit ¼–½ inch long; seed ovoid, acute, slightly ridged. Western and southern Texas to central Mexico.—Introduced to Europe in 1841; hardy only in the Southern States.

Also the following species, not or scarcely known in this country, belong to this affinity, having dark blue fruit and ciliolate leaves:

J. Wallichiana, Hook. Tree to 60 feet tall, with spreading branches, or shrub; branchlets slender: scale-like leaves free at the acute tips, bright green, furrowed and glandular on back; acicular leaves in 3's: flowers diœcious: fruit upright, ovoid, about ½ inch long, 1-seeded. Himalayas.—Introduced to England in 1849.

J. pseudosabina, Fisch. & Mey. Low shrub closely related to the preceding, but leaves less acute and fruit smaller, recurved, often globose. Altai Mountains, Turkestan.—Introduced some time before 1900. Hardy north.

J. saltuaria, Rehd. & Wils. Tree to 50 feet tall: leaves bright green, closely appressed, slightly incurved at the acute or obtusish apex, slightly glandular: flowers monœcious: fruit erect, subglobose or ovoid, about ¼ inch long, black, not bloomy, 1-seeded. Western China.—Introduced in 1904.

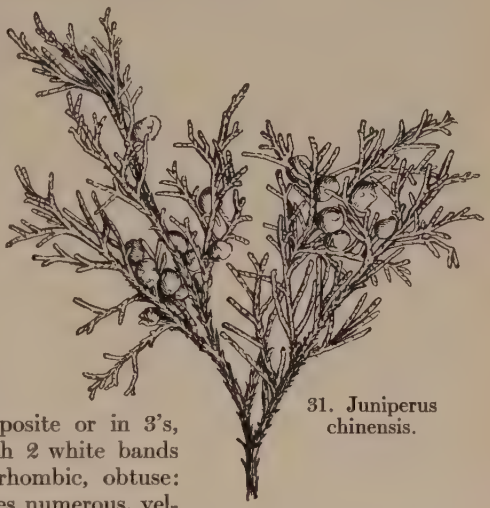
J. thurifera, L. (*J. sabinoides*, Griseb., in part. *Sabina thurifera*, Ant.). Tree to 40 feet, usually narrow-pyramidal in cultivation; branchlets pinnately ramified, slender: leaves scale-like, free at the acuminate apex, glandular, like the acicular ones opposite: fruit subglobose, about ⅓ inch across, 2–4-seeded. Southwestern Europe, northern Africa.—Introduced before 1750 to Great Britain. This differs from all the preceding species of the section Sabina in having also the acicular leaves opposite and from No. 12 and the four preceding species in the 2–4-seeded fruit.

13. **J. excelsa,** Bieb. Greek J. Pyramidal tree to 60 feet tall, with upright or spreading branches: leaves usually scale-like, on smaller branchlets opposite, closely appressed, rhombic-ovate, with incurved acute apex, glandular on back, dark or bluish-green, on leading shoots usually in 3's, acute, free at apex; acicular leaves opposite, with 2 glaucous bands above, ⅕–¼ inch long:

fruit globose, about ⅓ inch across, dark purplish-brown, covered with bluish bloom, 4–6-seeded. Greece, western Asia, and Caucasus.—Introduced in 1836 to England. Hardy as far north as New York.

Var. **stricta,** Rollisson (var. *Perkinsii*, Gord. var. *venusta*, Gord.). SPINY GREEK J. Columnar form with juvenile glaucous foliage.

14. **J. procera,** Hochst. AFRICAN J. Tree to 100 or 150 feet tall, similar to the preceding: leaves in 3's, or opposite, lanceolate and spreading or loosely appressed and ovate-lanceolate: fruit globose, small, about ¼ inch across, 2–3-seeded. Mountains of eastern Africa.—Cultivated in California, reintroduced by E. H. Wilson in 1921. Probably the tallest species of the genus.



31. Juniperus chinensis.

15. **J. chinensis,** L. (*J. sinensis*, Hort.). CHINESE J. Fig. 31. Tree to 60 feet, or shrub, sometimes procumbent; branches rather slender: acicular leaves opposite or in 3's, linear, pointed and spreading, with 2 white bands above, or scale-like, appressed, rhombic, obtuse: flowers dioecious; the staminate ones numerous, yellow, often on branchlets with juvenile foliage: fruit globular, brownish-violet, bloomy, ¼–⅓ inch across, with 2 or 3 seeds, ripening the second year. Himalayas, China, Japan.—Introduced to England before 1767. A variable species of which many garden forms are in cultivation.

Variegated forms: Var. **albo-variegata,** Veitch (var. *argenteo-variegata*, Hort.). WHITELEAF CHINESE J. A compact shrub with the tips of the branchlets creamy-white; the leaves mostly scale-like. Var. **aurea,** Young (var. *mascula aurea*, Hort.). GOLDEN CHINESE J. Upright form with scale-like foliage, the young growth golden-yellow.

Pyramidal or columnar forms: Var. **mas,** Gord. (var. *mascula*, Carr. var. *struthiacea*, Knight). A dense conical form with mostly acicular leaves and with staminate flowers. Var. **neaboriensis,** Beiss. (*J. neaboriensis*, Hort., not Gord.). A dense conical form with scale-like and acicular leaves. Var. **pyramidalis,** Carr. Narrow-pyramidal form, with bluish-green, mostly needle-shaped foliage.

Spreading and pendulous forms: Var. **pendula,** Franch. With spreading branches, pendulous at the extremities. Var. **Pfitzeriana,** Spaeth. PFITZER

J. Plate XIII. Forming a broad pyramid with horizontally spreading branches and nodding branchlets, grayish-green. Var. **fœmina,** Gord. (*J. Reevesiana,* Knight). Reeves J. A form with slender spreading branches and scale-like foliage, bearing female flowers and fruit.

Dwarf globose forms: Var. **globosa,** Horn. (*J. virginalis globosa,* Hort.). A dwarf and dense subglobose form with short, crowded, thickish branchlets clothed with bright green scale-like leaves; with only few small branchlets with acicular leaves on the lower part of the branches. Recently introduced from Japan, like the following. Var. **aureo-globosa,** Rehd. (*J. virginalis globosa* "golden," Hort.), is a form of similar habit, but with the younger branchlets more or less golden-yellow.

Var. **japonica,** Vilm. (*J. japonica,* Hort. *J. chinensis* var. *procumbens,* Hort., not Endl.). Japanese J. Low shrub with spreading, sometimes procumbent branches and usually acicular leaves in 3's. Introduced in 1862 from Japan into this country. Variegated forms are **"japonica aurea,"** Mast. (*J. japonica aurea,* Carr.). Golden Japanese J. The foliage tinged with golden-yellow, and var. **"japonica aureo-variegata,"** Mast. (*J. japonica aureo-variegata*), Variegated Japanese J., with part of the foliage golden-yellow.

Var. **Sargentii,** Henry. Sargent J. Plate XIV. A prostrate shrub with long creeping stem and ascending branchlets forming dense mats: adult plants with the leaves mostly scale-like and bluish-green, acicular and grass-green on young plants: fruit bluish, slightly bloomy. Japan, Saghalin, and Kurile Islands. —Introduced in 1892 by C. S. Sargent to America. A handsome form valuable as a ground-cover. This and the preceding variety have been confused often with *J. procumbens,* Endl., but that species has the leaves always acicular and in 3's and marked on the back with 2 conspicuous white spots near the base from which glaucous bands extend down the edges of the pulvini.

The plant now in cultivation as *J. sphaerica,* Lindl., does not differ from *J. chinensis.*

16. **J. bermudiana,** L. (*J. barbadensis,* L.). Bermuda J. Tree to 40 feet tall, in habit much like *J. virginiana,* but branches much stouter and foliage pale bluish-green; branchlets thickly set, quadrangular, stout and short: leaves mostly imbricate, thick or acicular, spiny-pointed, rigid, erect-spreading: staminate catkins larger: fruit usually 2-seeded and depressed-globular. Bermuda, Barbadoes, Antigua.—Introduced to England before 1684. Hardy only in the Southern States, but probably not in cultivation in this country.

17. **J. lucayana,** Britt. (*J. australis,* Pilger. *J. barbadensis,* Auth., not L. *J. virginiana* var. *barbadensis,* Gord.). Southern Red-Cedar. Tree to 50 feet tall, with spreading branches and slender pendulous 4-angled branchlets: leaves light green, closely appressed, ovate, sharp-pointed, glandular: fruit globose, about ⅙ inch thick, dark blue, bloomy, 1–2-seeded. Southern Georgia to Florida, eastern Texas, Jamaica, Cuba, Bahamas, Haiti.—One of

the most beautiful of the junipers, often planted for ornament in the Gulf States, and in the West Indies.

Var. **Bedfordiana,** Rehd. (*J. virginiana Bedfordiana,* Knight. *J. virginiana* var. *gracilis,* Sarg.). A juvenile form with light green acicular foliage and slender pendulous branchlets.

18. **J. virginiana,** L. Red-Cedar. Plate III. Tree to 100 feet tall, with conical head and spreading or upright branches: leaves acicular, spiny-pointed, spreading, or scale-like, rhombic, acute or subacute, imbricate, very small: fruit brownish-violet, bloomy, globular or ovoid, ¼–⅓ inch across. Canada to Florida, east of the Rocky Mountains.—Introduced before 1660 to England. A very variable species of which many garden forms are in cultivation.

Forms differing in color: Var. **albo-spica,** Beiss. Whitetip R. Tips of branchlets white; here belongs "Triomphe d'Angers" with the variegation more constant and more conspicuous. Var. **variegata,** Laws. (var. *albo-variegata,* Beiss.). Branchlets variegated with white. Var. **elegantissima,** Hochst. Goldtip R. Pyramidal tree with the tips of the branchlets golden-yellow. Var. **plumosa,** Rehd. (var. *plumosa alba,* Beiss.). Feather R. A pyramidal form with mostly acicular foliage and white or whitish tips. Var. **glauca,** Carr. Silver R. Vigorous form with very glaucous foliage.

Pyramidal or columnar forms: Var. **pyramidalis,** Carr. Dense columnar form. Var. **venusta,** Rehd. (*J. venusta,* Ellw. & Barry). A columnar form with glossy dark green foliage. Var. **Canaertii,** Sénécl. (var. *Cannartii,* Beiss.). Canaert R. A compact pyramidal form with dark green foliage and bluish bloomy fruits. Var. **Schottii,** Gord. Schott R. A comparatively small columnar tree with bright green scale-like foliage. Var. **Keteleeri,** Hort. Compact pyramidal form with ascending branches and dark green scale-like foliage. Var. **pyramidiformis,** D. Hill. A pyramidal form with bright green foliage in summer, coloring soft purple in autumn and winter. Var. **filifera,** D. Hill. Broad-pyramidal form with slender, much divided branchlets and blue-gray foliage.

Dwarf compact forms: Var. **globosa,** Beiss. Globe R. A compact-globose form with bright green scale-like foliage.

Spreading or pendulous forms: Var. **Chamberlaynii,** Carr. Chamberlayn R. With spreading branches and elongated pendulous branchlets: leaves dimorphic, grayish-green. Var. **pendula,** Carr. Weeping R. With spreading limbs and slender, pendulous branches: leaves usually scale-like.

Dwarf, spreading or procumbent forms: Var. **tripartita,** R. Smith. Fountain R. A dwarf, spreading form of irregular habit, densely branched, with acicular, glaucous leaves. Var. **reptans,** Beiss. (var. *horizontalis,* Arb. Kew.). Creeping R. Low shrub, with horizontally spreading branches and slender curving branchlets: bright green.

19. **J. scopulorum,** Sarg. (*Sabina scopulorum,* Rydb.). Colorado R.

Closely allied to the preceding; chiefly distinguished by the somewhat larger fruit, ripening not until the second year; by its habit, forming a broad head with stout spreading branches and often dividing into several stems near the base; and by its shredding bark. The branchlets are somewhat shorter and stouter, and the foliage usually glaucous or yellowish-green. British Columbia to California in the Rocky Mountains.—Introduced to England probably first in 1836.

Var. **argentea,** D. Hill. A narrow-pyramidal form with silvery-white foliage.

Var. **viridifolia,** D. Hill. A pyramidal form with striking bright green foliage.

Var. **horizontalis,** D. Hill. Upright form with horizontally spreading branches and bluish-white foliage.

20. **J. horizontalis,** Moench (*J. prostrata,* Pers. *J. Sabina* var. *procumbens,* Pursh. *J. repens,* Nutt.). Creeping J. Plate XVI. Procumbent, usually with long trailing branches furnished with numerous short branchlets, sometimes to 4 feet high and with spreading branches: leaves of young plants subulate, mature foliage imbricate, scale-like, acute or acutely cuspidate, bluish-green or steel-blue: fruit about ⅓ inch across, blue, slightly glaucous, on a pedicel shorter than its length. Nova Scotia to British Columbia, south to Massachusetts, New York, Minnesota, and Montana.—Introduced to Europe before 1800. Hardy to northwestern Canada and valued as a ground-cover for sandy and rocky soil in exposed situations.

Var. **Douglasii,** Rehd., is a distinctly trailing form with steel-blue foliage, turning purple in autumn with glaucous bloom; also called Waukegan juniper.

21. **J. Sabina,** L. Savin. Spreading or procumbent shrub, rarely with erect stem, to 10 feet, branchlets rather slender, of a very strong disagreeable odor when bruised: leaves needle-shaped, acute, and slightly spreading or imbricate, oblong-rhombic, obtuse or subacute, usually dark green: fruit ⅛–¼ inch thick, globular, 1–3-seeded. Mountains of central and southern Europe, western Asia, and Caucasus.—Introduced to England before 1584; hardy as far north as Canada.

Var. **variegata,** Beiss. Hoarfrost Savin. Branchlets variegated with creamy-white: leaves mostly imbricate.

Var. **fastigiata,** Beiss. Column Savin. Erect shrub of columnar habit, with dark green mostly scale-like leaves.

Var. **cupressifolia,** Ait. (var. *humilis,* Endl.). Procumbent, with ascending thickish branchlets: leaves usually imbricate, scale-like, often bluish-green.

Var. **tamariscifolia,** Ait. Tamarix Savin. Procumbent or ascending, rarely erect: leaves usually all needle-shaped and often in 3's, slightly incurved, free at the tip and sharply pointed, dark green, with a white band above, often bluish-green.

2. CUPRESSUS, L. CYPRESS

Evergreen trees, rarely shrubby, with aromatic foliage, the bark usually separating in long shred-like scales; branchlets quadrangular or terete, rarely compressed: leaves opposite, small, scale-like, appressed, minutely denticulate-ciliate, on young seedling plants linear-subulate and spreading: flowers monœcious, minute, solitary on short branchlets, the two sexes on separate branches; staminate ovate or oblong, yellow, composed of 6–12 decussate stamens; fertile flowers subglobose: cones globular or nearly so, consisting of 3–7 pairs of ligneous peltate scales, with a mucro or boss on the flattened apex, each bearing many or numerous seeds, but the lower scales usually sterile and smaller; they ripen the second year. (*Cupressus* is the ancient Latin name of the cypress-tree, derived from the Greek *kuparissos.*)—About 12 species in Pacific North America and Mexico and in the Old World from southeastern Europe to the Himalayas and China.

Many species are favorite ornamental trees in warm-temperate and subtropical regions. In their native countries most of the species are valuable timber trees; their wood is close-grained and very durable in the soil and in water.

A. Branchlets irregularly ramified, the ultimate branchlets not in one plane.
  B. Apex of leaves obtuse or obtusish, dark green.
    C. Leaves not at all or not conspicuously glandular: cones 1-1½ inches across.
      D. Length of leaves $\frac{1}{25}$ inch: staminate flowers with 10–12 stamens ..... 1. *C. sempervirens*
      DD. Length of leaves $\frac{1}{16}$ inch: staminate flowers with 6–8 stamens ..... 2. *C. macrocarpa*
    CC. Leaves conspicuously resinous-glandular: cone ¾–1 inch long ..... 3. *C. Macnabiana*
  BB. Apex of leaves acute.
    C. Leaves dark green: usually small tree or shrub with ascending or spreading branches: cone ⅓–1 inch across ..... 4. *C. Goveniana*
    CC. Leaves pale bluish-green or glaucescent: cone ¾–1¼ inches across.
      D. Branches upright or spreading; branchlets terete.
        E. Color of branchlets bright red, slender: leaves with small gland-pits ..... 5. *C. guadalupensis*
        EE. Color of branchlets gray, stout: leaves glandless or conspicuously resinous-glandular ..... 6. *C. arizonica*
      DD. Branches spreading, drooping at the extremities; branchlets slightly compressed ..... 7. *C. lusitanica*
AA. Branchlets regularly pinnately ramified, ultimate branchlets in one plane, slender, drooping.
  B. Cone ½–¾ inch across: branchlets not or slightly compressed.

c. Leaves of branchlets acute, often free at tip: branchlets slightly compressed.....7. *C. lusitanica* [*Benthami* var.
cc. Leaves obtusish: branchlets terete.....8. *C. torulosa*
bb. Cone ⅓–½ inch across: branchlets distinctly flattened, dark green.....9. *C. funebris*

32. Cupressus sempervirens.

1. **C. sempervirens,** L. Italian Cypress. Fig. 32. Tree to 80 feet with erect or horizontal branches and dark green foliage; trunk with thin gray bark, smooth or slightly longitudinally fissured: leaves closely appressed, ovate, obtuse, glandular: staminate flowers with 10–12 stamens: cones short-oblong or nearly globose; scales 8–14, with a short boss on the back, bract free at the apex; seeds 8–20 under each scale. Southern Europe and western Asia.—Much planted since ancient times in southern Europe particularly in its columnar form. It is hardy only in the Southern States and California.

Var. **stricta,** Ait. (var. *pyramidalis,* Nym. var. *fastigiata,* Beiss. *C. fastigiata,* DC.). Columnar Italian C. Tree with erect branches, forming a narrow, columnar head. The classical cypress of the Greek and Roman writers.

Var. **indica,** Parl. (*C. Royleі,* Carr. *C. Whitleyana,* Hort.). Globecone Italian C. Similar to var. *fastigiata* in habit: cones globose, with 10 scales; bract acutely mucronate at the apex.

Var. **horizontalis,** Gord. (*C. horizontalis,* Mill.). Spreading Italian C. Branches horizontally spreading, forming a broad pyramidal head.

2. **C. macrocarpa,** Hartw. (*C. Hartwegii,* Carr. *C. Lambertiana,* Gord.). Monterey C. Tree to 40, occasionally to 70 feet tall, with horizontal branches forming a broad spreading head; bark ridged, dark reddish-brown, separating into thick persistent scales; branchlets stout: leaves rhombic-ovate, swollen toward the tip, obtuse, closely appressed, not or obscurely glandular, dark or bright green: staminate flowers with 6–8 stamens: cones globular or oblong; scales 8–12, with a short obtuse boss on the back; seeds about 20. California, Bay of Monterey.—Introduced to Europe in 1838.

Var. **lutea,** Webster. Yellow Macnab C. An upright, fastigiate form with yellow foliage changing to green the second year.

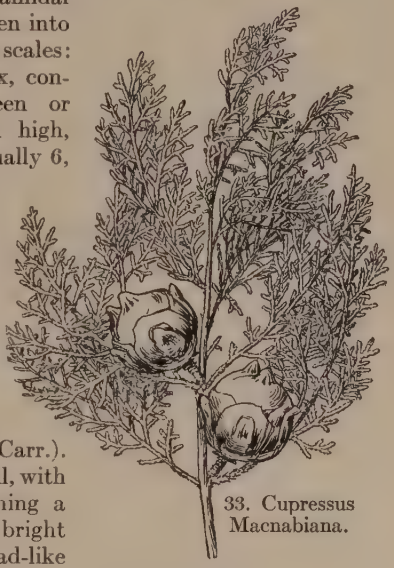
Var. **fastigiata,** Mast. Branches ascending, forming a compact fastigiate head.

PLATE XLI. The Deodar cedar (*Cedrus Deodara*)

PLATE XLII. A good specimen of Austrian pine (*Pinus nigra*)

Var. **Crippsii,** Gord. CRIPPS C. A juvenile form with rigid short branchlets and spreading sharp-pointed leaves; the tips of young branchlets silvery-white.

3. **C. Macnabiana,** Murray (*C. glandulosa,* Hook. *C. Bakeri,* Jeps. *C. nevadensis,* Abrams). MACNAB C. Fig. 33. Shrub with several stems, or small tree to 20 feet, forming a dense pyramidal head; bark dark reddish-brown, thin, broken into ridges and separating into slightly attached scales: leaves ovate, obtuse, thickened at the apex, conspicuously resinous-glandular, dark green or glaucous: cones short-oblong, ¾–1 inch high, dark red-brown, often glaucous; scales usually 6, with prominent conical and curved bosses on the back. California and southern Oregon.—Introduced to England in 1854 by Wm. Murray. This is apparently the hardiest species of the genus; plants raised from seed from the northern limit of its range have survived the last two winters out-of-doors in the Arnold Arboretum.



33. Cupressus Macnabiana.

Var. **sulphurea,** Berckmans. Branchlets with golden tips.

4. **C. Goveniana,** Gord. (*C. californica,* Carr.). GOWEN C. Tree to 50, rarely to 75 feet tall, with slender, erect or spreading branches, forming a broad, open or pyramidal head; bark bright reddish-brown, separating into thin thread-like scales; branchlets slender: leaves ovate, acute, closely appressed, inconspicuously glandular: abundant staminate flowers in spring: cones subglobose or short-oblong, ½–¾ inch across; scales 6–8, with short blunt bosses; seed brown or nearly black. California.—Introduced in 1846 to England by T. Hartweg.

Var. **pygmæa,** Lemm. (*C. pygmæa,* Sarg.). Low shrub: cones smaller, with small black seeds. Mendocino County.

Var. **Sargentii,** Henry (*C. Sargentii,* Jeps.). Shrub or small tree to 15 feet tall: leaves with a small glandular pit on back: cones globose, often congested, ¾–⅘ inch across, with reddish-brown often glaucous seeds. Middle and southern California.

5. **C. guadalupensis,** Wats. (*C. macrocarpa* var. *guadalupensis,* Mast.). GUADALUPE C. Wide-spreading tree, 40 feet high or more; bark grayish-brown, lustrous, exfoliating, brownish-red below; branchlets drooping, slender: leaves bluish-green, scentless, acute or acutish, obscurely glandular:

cones globose, 1 inch across or more, with 6–8 very thick strongly bossed scales. Guadeloupe Islands, southern and Lower California.—Introduced about 1880 to Europe.

6. **C. arizonica,** Greene (*C. Benthami* var. *arizonica*, Mast.). Arizona C. Tree to 40, rarely to 70 feet tall, with horizontal short branches, forming a narrow, pyramidal, or broad, open head; bark on young trees separating into large, thin, deciduous scales leaving a smooth red surface, on older trunks fibrous and dark red-brown; branchlets stout: leaves pale green or glaucous, ovate, obtuse, thickened at the apex, usually without glands: cones subglobose to broadly ellipsoidal, dark red-brown and bloomy, ¾–1 inch across; scales 6–8, with stout, pointed, often curved bosses. Eastern Arizona, New Mexico, and northern Mexico.—Doubtful whether in cultivation.

Var. **bonita,** Lemm. (*C. glabra*, Sudw.). Smooth C. Leaves with conspicuous resinous gland on back, more or less glaucous: cone 1–1⅓ inches across; the scales with a short mucro. Central and southern Arizona.—Introduced to Europe in 1882 (as *C. arizonica*). This is, next to *C. Macnabiana*, the hardiest cypress and probably hardy as far north as New York. Young plants with juvenile foliage are very glaucous (var. *glauca*, Woodall).

7. **C. lusitanica,** Mill. (*C. glauca*, Lam. *C. Lindleyi*, Klotzsch. *C. pendula*, L'Hér. *C. sinensis*, Hort.). Portuguese C. Tree to 50 feet, with spreading branches and more or less pendulous, irregularly ramified, slightly compressed branchlets; trunk with reddish-brown bark fissured into long narrow strips: leaves ovate, acutish, appressed, slightly free at tips, glaucous: cones peduncled, about ½ inch across, covered with glaucous bloom; scales 6–8, with an elongated, pointed and usually hooked boss. Mexico.—Introduced to Portugal about 1600. For a long time supposed to have come from India and called "Cedar of Goa."

Var. **Benthami,** Carr. (*C. Benthami*, Endl. *C. thurifera*, Schlecht., not HBK. *C. excelsa*, Scott). Bentham C. Narrow pyramidal tree with spreading or deflexed branches; branchlets pinnately and regularly ramified in one plane, the ultimate branchlets slightly compressed: leaves acute, free at the tips, with a glandular pit on back.—Introduced about 1840.

Var. **Knightiana,** Rehd. (*C. Knightiana*, Knight & Perry. *C. Benthami* var. *Knightiana*, Mast.). Knight C. Similar to the preceding variety, but branchlets more compressed and very regularly pinnately branched, the ultimate branchlets of nearly equal length, green to glaucous.—Introduced before 1850.

8. **C. torulosa,** D. Don (*C. nepalensis*, Loud.). Bhutan C. Tall pyramidal tree to 150 feet high, with short horizontal branches ascending at the extremities; trunk with brown bark peeling off in long, narrow, fibrous strips; branchlets slender, drooping: leaves rhombic-ovate, acutish or obtusish, appressed or slightly spreading at the apex, bright or bluish-green: cones

globular, nearly sessile, ½–¾ inch across; scales 8–10 with a short, obtuse, inconspicuous boss. Himalayas.—Introduced to Great Britain in 1824 by Wallich.

Var. **Corneyana,** Carr. (*C. Corneyana,* Knight). Branches and branchlets pendulous; the branchlet-systems not distinctly distichous.—Introduced before 1850.

9. **C. funebris,** Endl. (*C. pendula,* Lambert). MOURNING C. Fig. 34. Tree to 60 feet tall, with wide-spreading, pendulous branches and branchlets; branchlets flattened; trunk with brown smooth bark: leaves deltoid-ovate, acute, light green, often slightly spreading at the apex: cones short-peduncled, globose, ⅛–½ inch across; scales 8, with a short-pointed boss. China.—Introduced in 1850 to Great Britain by Fortune.

A related species is **C. cashmeriana,** Royle (*C. torulosa* var. *kashmiriana,* Kent. *C. funebris* var. *glauca,* Mast.). KASHMIR C. Tree with ascending branches and pendulous branchlets; branchlets compressed: lateral leaves spreading: cones dark brown, ellipsoidal, nearly ½ inch across; scales 10 with triangular reflexed umbo. Kashmir.—Introduced about 1862.

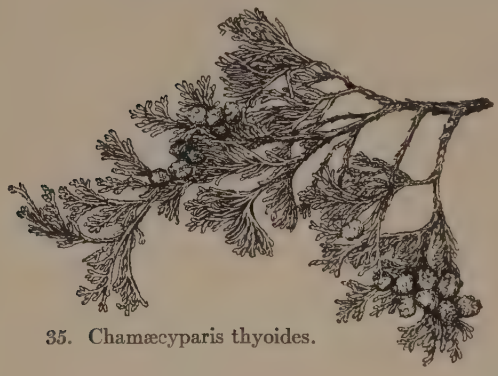
34. Cupressus funebris.

3. CHAMÆCYPARIS, Spach. CYPRESS

Evergreen trees with scaly or fissured bark; the leading shoots nodding; branchlets usually flattened and pinnately ramified: leaves scale-like (only in the juvenile state subulate), opposite and decussate, densely clothing the branchlets: flowers monœcious, small; the fertile ones inconspicuous, globose; staminate yellow or red, oblong, often conspicuous by their abundance: cones small, globular, with 6–11 bracts, each bearing 2, rarely up to 5, winged seeds, ripening the first season. (Apparently an adaptation from Pliny's Chamæcyparissus, "ground-cypress," derived from Greek *chamai,* on the ground, and *kuparissos,* cypress, though its species are not lower but generally decidedly taller than the true cypresses.)—Six species in North America and Asia. Closely allied to Cupressus, which differs in its larger cones maturing the second year, the bracts containing 4 or more seeds, and in its quadrangular branches and minutely denticulate leaves.

Cypresses are valuable timber trees in their native countries and belong, with their numerous garden forms, to our most important ornamental conifers.

A. Lateral leaves not much larger than the facial ones, both of about equal length on the main axis.
B. Branchlets not distinctly pinnately arranged, compressed, slender, glandular, bluish-green ..... 1. *C. thyoides*
BB. Branchlets pinnately arranged in one plane.
C. Leaves dark green, not glandular, without white markings below: branchlets nearly 4-sided, stout ..... 2. *C. nootkatensis*
CC. Leaves with glaucous or whitish markings below: branchlets flattened ..... 3. *C. pisifera*
AA. Lateral leaves much larger than the facial ones, longer than the latter on the main axis, all closely appressed.
B. Leaves obtuse, not glandular, lustrous dark green above, with distinct white markings below ..... 4. *C. obtusa*
BB. Leaves acute or acutish, glandular, bright green or more or less glaucous, the white markings below sometimes indistinct ..... 5. *C. Lawsoniana*



35. Chamæcyparis thyoides.

1. C. thyoides, Britt. (*C. sphæroidea,* Spach. *Cupressus thyoides,* L.). White-Cedar. Fig. 35. Tree to 70 or 80 feet, with erect-spreading branches; trunk with reddish-brown fissured bark divided into flat connected ridges; branchlets irregularly arranged, spreading, not pendulous, very thin and slender, flattened: leaves closely imbricate on the leading shoots, spreading at the apex, acute, keeled, glaucous or light green, with a conspicuous gland on the back, fragrant: cones small, ¼ inch diameter, bluish-purple, with glaucous bloom; seeds 1 or 2, with wings as broad as the seed. From Maine southward near the coast to Florida and west to Mississippi.—Introduced to Great Britain in 1736. The least ornamental and the hardiest of the species, being hardy as far north as Canada.

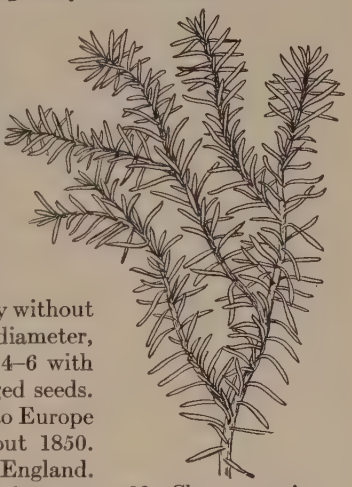
Var. **variegata,** Sudw. (*Cupressus thyoides variegata,* Loud.). Variegated White-Cedar. Branchlets partially colored golden-yellow.

Var. **glauca,** Sudw. (*C. sphæroidea glauca,* Endl. var. *kewensis,* Hort.). Blue White-Cedar. Of compact habit, very glaucous, with silvery hue.

Var. **andelyensis,** Schneid. (*C. sphæroidea andelyensis,* Carr. *C. leptoclada,* Hochst. *Retinispora leptoclada,* Hort., not Zucc.). Andely Retinispora. Intermediate form between the following varieties and the type; bluish-green and of erect growth, with loosely appressed lanceolate leaves; often some branchlets with leaves of the type and some with leaves of the var. *ericoides.*

Var. **ericoides,** Sudw. (*C. ericoides,* Carr. *Retinispora ericoides,* Hort.). CEDAR RETINISPORA. Fig. 36. Compact shrub, of erect dense habit: leaves linear-lanceolate, spreading, with 2 glaucous lines beneath, coloring in winter usually reddish-brown. This and the preceding are juvenile forms.

2. **C. nootkatensis,** Sudw. (*Cupressus nootkatensis,* Lambert. *C. nutkaensis,* Spach. *Thuyopsis borealis,* Hort.). NOOTKA C. (YELLOW CEDAR). Tree to 120 feet, with ascending branches, pendulous at the extremities; trunk with brownish-gray irregularly fissured bark separating into large thin scales; branchlets distichously arranged, on the upper part of the tree in vertical planes, slightly flattened or nearly quadrangular, pendulous: leaves densely imbricate, usually dark green, acute, on the leading shoots spreading at apex, mostly without glands: cones subglobose, nearly ½ inch diameter, dark red-brown, with glaucous bloom; scales 4–6 with erect pointed bosses, each with 2–4 broad-winged seeds. Southwestern Alaska to Oregon.—Introduced to Europe through the Petrograd Botanic Garden about 1850. Hardy as far north as Ontario and New England. Handsome tree of pyramidal shape with dark green lustrous foliage, the branchlets with more or less pendulous tips.



36. Chamæcyparis thyoides var. ericoides.

Var. **glauca,** Beiss. (*Thuyopsis borealis* var. *glauca,* Jaeger). BLUE NOOTKA C. With very glaucous foliage.

Var. **lutea,** Beiss. The young growth colored light yellow.

Var. **pendula,** Beiss. A form with distinctly pendulous branches.

Var. **compacta,** Beiss. A dwarf compact form.

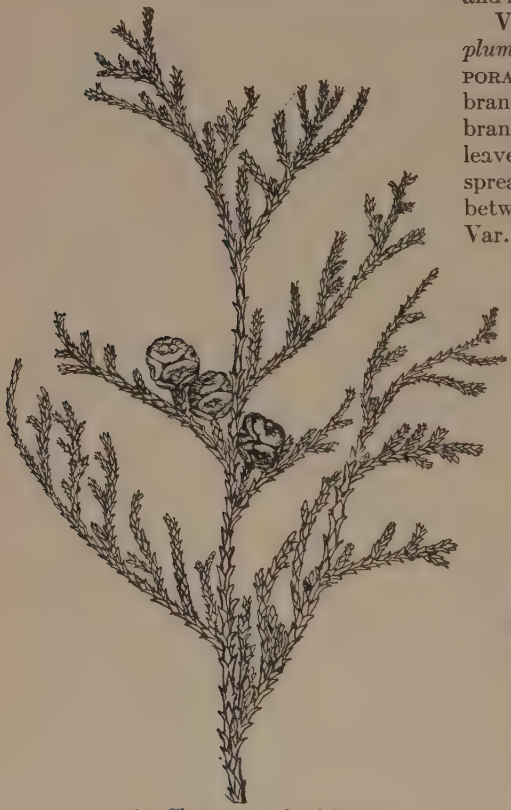
3. **C. pisifera,** Sieb. & Zucc. (*Cupressus pisifera,* Koch. *Retinispora pisifera,* Sieb. & Zucc.). SAWARA C. Fig. 37 and Plate XVIII. Tree to 100 feet tall, with horizontal branches; trunk with red-brown, thin, rather smooth bark peeling off in thin strips; branchlets flattened, distichously arranged in horizontal planes and somewhat pendulous: leaves ovate-lanceolate, with mucronate tips, slightly spreading, obscurely glandular, shining above, with whitish lines beneath: cones globular, ¼–⅓ inch diameter, brown; scales 10, rarely 12, with a small mucro at the depressed center, each scale with 1–2 broad-winged seeds. Japan.—Introduced in 1861 by J. G. Veitch to Great Britain and the following year by Dr. G. R. Hall to America. Hardy as far north as southern Ontario and New England. A tree of fairly rapid growth with a narrow-pyramidal rather loosely branched head, the horizontal branches

more or less ascending at the extremities; it is a thinner tree than the other species of the genus and is likely to lose its lower branches rather early.

Var. **aurea,** Carr. GOLDEN SAWARA C. A form with golden-yellow foliage.

Var. **sulphurea,** Schelle. A form with light yellow foliage.

Var. **filifera,** Beiss. (*Retinospora filifera*, Standish. *C. obtusa filifera*, Hort.). THREAD RETINISPORA. Fig. 38. Branches elongated and slender, thread-like, gracefully pendulous, with distant branchlets and leaves. Very decorative forms. Var. **"filifera aurea,"** Beiss. A form of var. *filifera* with the young growth golden-yellow. Var. **"filifera aureo-variegata,"** Beiss. A form of var. *filifera* with the branchlets variegated with yellow, but less elongated and less thread-like.



37. Chamæcyparis pisifera.

Var. **plumosa,** Beiss. (*Retinospora plumosa*, Veitch). PLUME RETINISPORA. PLATE XXXV. Habit conical; branches almost erect, with slender branchlets of feathery appearance: leaves subulate, pointed and slightly spreading, bright green. Intermediate between the type and var. *squarrosa*. Var. **"plumosa argentea,"** Beiss. SILVERTIP RETINISPORA. Tips of branchlets whitish. Var. **"plumosa aurea,"** Beiss. (*Reti-*

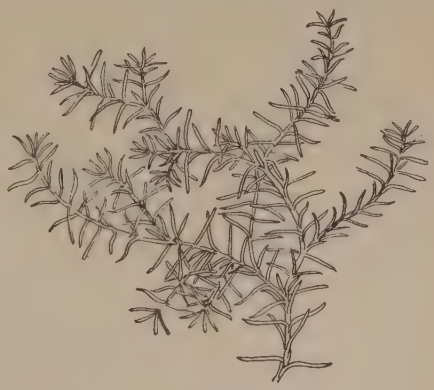
38. Chamæcyparis pisifera var. filifera.

nospora plumosa aurea, Standish). Golden Plume Retinispora. Fig. 39. Young growth of golden-yellow color. A very showy form. Var. **"plumosa flavescens,"** Beiss. (*Retinispora plumosa sulphurea*, Hort.). Tips of the young branchlets yellowish.

Var. **squarrosa,** Beiss. & Hochst. (*Retinispora squarrosa*, Sieb. & Zucc. *R. leptoclada*, Zucc.). Moss Retinispora. Fig. 40. Densely branched bushy tree or shrub, with spreading feathery branchlets: leaves linear, spreading, glaucous above, silvery below. A very distinct and beautiful variety. Var. **"squarrosa sulphurea,"** Beiss. A form with yellow foliage.

39. Chamæcyparis pisifera var. plumosa aurea.

A closely related species is **C. formosensis,** Matsum. (*Cupressus formosensis*, Henry). Formosan C. Tall tree, occasionally to 190 feet high, with a trunk 20 feet in diameter and with spreading branches pendulous at the extremities; branchlets dull green on both sides or slightly bloomy below: leaves appressed, free at the incurved apex, obscurely glandular: cones short-ellipsoidal, ¼–⅓ inch across; scales with a conspicuous, broadly triangular boss; seeds 2 under each scale, narrow-winged. Formosa.—Introduced in 1911 to Great Britain by Shirasawa; not in cultivation in this country.



40. Chamæcyparis pisifera var. squarrosa.

4. **C. obtusa,** Sieb. & Zucc. (*Cupressus obtusa*, Koch. *Retinispora obtusa*, Sieb. & Zucc.). HINOKI C. Tree to 120 feet tall, with horizontal branches; trunk with reddish-brown, rather smooth bark, peeling off in thin strips; branchlets frond-like, arranged in horizontal planes, flattened, pendulous: leaves bright green and shining above, with whitish lines beneath, thickish, the facial ones rhombic-ovate, obtuse, and very closely appressed, with a gland on the back, the lateral ones free at the acutish apex: cones globose, nearly ½ inch diameter, brown; scales 8, rarely 10, with a small mucro on the depressed back, each with 2, rarely 3–5 narrowly winged seeds. Japan.—Introduced in 1861 to Great Britain by J. G. Veitch and in 1862 to America by Dr. G. R. Hall. Hardy as far north as Ontario and New England. A handsome tree with dark green lustrous foliage.

Color forms: Var. **albo-spicata,** Beiss. SILVERTIP HINOKI C. Young shoots at first creamy-white, changing later to pale green. Var. **aurea,** Beiss. GOLDEN HINOKI C. Young foliage golden-yellow. Var. **"aurea Youngii,"** Nash, is similar, but the branchlets are more pendulous and the color less bright. Var. **Crippsii,** Rehd. With pale yellow foliage. Var. **"gracilis aurea,"** Beiss. Graceful form, foliage bright yellow when young, changing later to greenish-yellow. Var. **tetragona,** Rehd. (var. *tetragona aurea*, Nichols). A dwarf, broad-pyramidal form, with crowded, irregular branchlet-systems, the branchlets more or less 4-angled and partly golden-yellow, the shaded parts green.

Forms differing in habit: Var. **magnifica,** Beiss. A vigorous form with stout branchlets and lustrous, bright green foliage. Var. **gracilis,** Nash (*Cupressus obtusa gracilis*, Lav.). SLENDER HINOKI C. Compact pyramidal form with dark green foliage; branchlets with slightly pendulous tips. Var. **erecta,** Beiss. (*Retinospora obtusa erecta*, Waterer). Fastigiate form with ascending branches and bright green foliage. Var. **lycopodioides,** Carr. CLUBMOSS RETINISPORA. Low form, of somewhat irregular habit, with spreading, rigid branches and thick, nearly terete, dark green branchlets; leaves very crowded and disposed in more than 4 ranks. Var. **filicoides,** Beiss. FERNSPRAY RETINISPORA. Of slow growth, with short and densely frond-like arranged branchlets. Var. **compacta,** Hartw. & Ruempl. (*Retinospora obtusa gracilis compacta*, Hort.). FOOTBALL C. Of dwarf and dense, broadly conical habit with much crowded short branchlets at the end of the short branches. Var. **nana,** Carr. DWARF HINOKI C. Plate XVIII. Low form, of slow growth, with short deep green branchlets. Var. **"nana aurea,"** Carr., is a form with the young growth golden-yellow. Var. **pygmæa,** Carr. (*C. obtusa breviramea*, Hort., not Beiss.). PYGMY HINOKI C. Very dwarf form, with horizontal, almost creeping branches, densely frond-like branched. Exceedingly interesting form for rockeries.

Juvenile form: Var. **ericoides,** Boehmer (*Retinospora Sanderi*, Sander.

Juniperus Sanderi, Hort.). Sander Retinispora. Fig. 41. Of low subglobose habit with bluish-gray, linear, spreading, blunt leaves about $\frac{1}{5}$ inch long, thickish, marked with a green line above.

Geographical variety: Var. **formosana,** Hayata. Tree to 130 feet tall; branchlets slenderer and thinner: cones subglobose, about $\frac{1}{3}$ inch across; seeds smaller. Formosa.—Introduced to the Arnold Arboretum by E. H. Wilson in 1918. Probably hardy only in the Southern States and California.

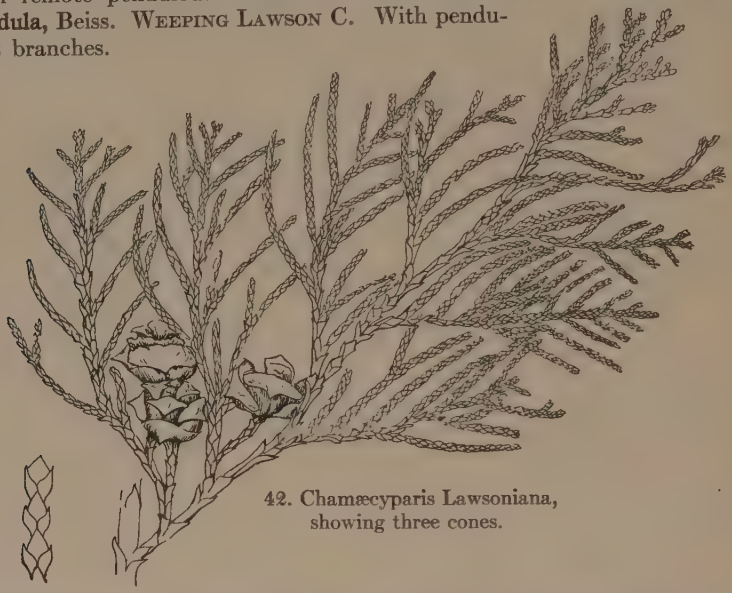
5. **C. Lawsoniana,** Parl. (*Cupressus Lawsoniana*, Murr. *C. Boursieri*, Decne.). Lawson C. Fig. 42 and Plate XIX. Tree to 200 feet, with horizontally spreading and usually pendulous branches; bark reddish-brown, thick, divided into rounded ridges covered with small scales; branchlets flattened, frond-like arranged in horizontal planes: leaves closely appressed, obtuse or somewhat acute, usually bright green, marked below with often indistinct white streaks, with a gland on the back: staminate catkins bright red (yellow in all other species): cone globose, about $\frac{1}{3}$ inch across, red-brown and often glaucous; scales 8, with a thin reflexed mucro, each with 2–4 broad-winged seeds. Southwestern Oregon to northwestern California.—Introduced in 1854 to England. Hardy as far north as New York and in sheltered positions to Massachusetts. This is one of the most beautiful conifers and it forms in cultivation usually narrow pyramidal trees densely furnished to the ground with branches; it is very variable and about 80 garden forms are known in European nurseries and collections.

41. Chamæcyparis obtusa var. ericoides.

Color forms: Var. **albo-spica,** Beiss. Cream C. Tips of branchlets creamy-white, of slender habit. Var. **argentea,** Beiss. (*Cupressus Lawsoniana argentea*, Gord.). Of slender habit, with very glaucous almost silvery foliage. Here belongs "Silver Queen." Var. **lutea,** Beiss. Golden Lawson C. Of compact habit, young growth clear yellow. Var. **glauca,** Beiss. Steel C. Foliage of metallic, glaucous tint. One of the hardier forms. Here belongs "Triomphe de Boskoop."

Forms of upright or columnar habit: Var. **Alumi,** Beiss. Scarab C. Of columnar habit, foliage very glaucous, with a bluish metallic hue. The best blue columnar form. Var. **Fraseri,** Beiss. Similar to the preceding, but less narrow in habit and with dark blue foliage. Var. **erecta,** Sudw. (var. *erecta viridis*, Beiss.). Green Column C. Dense columnar habit and bright green foliage. One of the most beautiful varieties, but somewhat tender. Var. **"erecta glauca,"** Beiss. Blue Column C. Similar in habit, but with glaucous foliage.

Forms of spreading and pendulous habit: **gracilis,** Beiss. (var. *gracilis pendula,* Hort.). FOUNTAIN LAWSON C. Elegant light green form, with graceful pendulous branchlets. Var. **intertexta,** Beiss. Glaucous growth, with remote pendulous branches and distant thickish branchlets. Var. **pendula,** Beiss. WEEPING LAWSON C. With pendulous branches.



42. Chamæcyparis Lawsoniana, showing three cones.

Compact or dwarf forms: Var. **Bowleri,** Beiss. A dense, compact form, with the tips of the branchlets elongated and pendulous. Var. **nana,** Beiss. (*C. Boursieri nana,* Carr.). DWARF LAWSON C. Dwarf globose habit. Var. **"nana glauca,"** Beiss., has the young growth bluish-green. Var. **"minima glauca,"** Beiss. Dwarf and compact conical form with dark steel-blue foliage.

4. THUJOPSIS, Sieb. & Zucc.

Evergreen tree with spreading branches; branchlets broad, much flattened and frond-like, arranged in horizontal planes: leaves opposite and decussate, with white markings below: staminate flowers with 6–10 decussate pairs of stamens: cones subglobose; scales 6–10, rhomboidal, imbricate, flat, woody, usually with a mucro below the apex, the upper pair sterile, the fertile scales with 3–5 winged seeds each; cotyledons 2. (Name derived from Thuja and Greek *opsis,* likeness; referring to its close relation to that genus.) Also spelled Thuyopsis or Thyopsis.—Only one species known.

T. dolobrata, Sieb. & Zucc. (*T. dolobrata* var. *australis,* Henry. *Thuja dolobrata,* L.). HIBA ARBOR-VITÆ. Fig. 43. Pyramidal tree attaining 50 feet, or sometimes shrubby; bark thin, reddish-brown, fissured longitudinally into long narrow strips; branches irregularly whorled or scattered, horizontally spreading and often nodding at the ends; branchlets $\frac{1}{5}$–$\frac{1}{4}$ inch broad: leaves glossy green above, marked with a broad white band beneath, those of the upper and under side obovate-oblong, obtuse, adnate except at the apex, the lateral ones spreading, ovate-lanceolate and curved (hatchet-shaped), obtusish: cone globose-ovoid, about $\frac{1}{2}$–$\frac{3}{5}$ inch long; scales with a prominent, often curved umbo below the apex. Central Japan.—Introduced to Holland in 1853; to America in 1861 by Dr. G. R. Hall. It has not proved very successful in the Eastern States and is not hardy much farther north than New York, though at Mattapoiset, Cape Cod, some fine specimens are growing. When well developed it is a handsome tree of dense, broad-pyramidal habit, with bright green lustrous foliage.

43. Thujopsis dolobrata.

Var. **variegata,** Fortune. WHITETIP HIBA ARBOR-VITÆ. Tips of branchlets creamy-white.

Var. **nana,** Sieb. & Zucc. (*T. lætevirens,* Lindl.). Dwarf form, with more slender and narrower branchlets of a lighter green.

Var. **Hondai,** Makino (*T. Hondai,* Henry). Tree to 70, or occasionally to 90 feet tall; branches more densely ramified and the branchlets placed close together and overlapping one another by their edges more than in the type: leaves smaller and whiter beneath: cone subglobose, $\frac{3}{5}$–$\frac{3}{4}$ inch across; scales less thickened at the apex and with the umbo reduced to a short mucro or narrow ridge. Northern Japan.—Introduced to the Arnold Arboretum in 1915 by E. H. Wilson, but has not proved hardy in Massachusetts, though it may be somewhat hardier than the type.

5. LIBOCEDRUS, Endl. INCENSE-CEDAR

Evergreen trees with scaly bark and spreading or erect branches; branchlets flattened, rarely quadrangular, frond-like in arrangement: leaves decussate, scale-like, with decurrent base, with or without glands: flowers monœcious or rarely dicœcious, terminal, similar to those of Thuja; the staminate ones with 12–16 decussate stamens: cones oblong to ovate, with 4, rarely 6, woody scales, the lower pair sterile, short and reflexed, the second one much larger and fertile, each scale bearing 2 long-winged seeds, the third pair, if present, connate into a woody septum, cotyledons 2. (Name derived from Greek *libas*, drop, tear, and *Cedrus;* alluding to the resinous character of the tree.) — Eight species in western North America, South America, New Zealand, New Caledonia, New Guinea, Formosa, and southwestern China.

44. Libocedrus decurrens.

L. decurrens, Torr. (*L. Craigana,* Low. *Thuya Craigana,* Murr. *T. gigantea,* Carr., not Nutt.). CALIFORNIA I. (WHITE CEDAR). Fig. 44. An ornamental tree to 100, occasionally to 200 feet tall, with erect or spreading short branches, forming a rather narrow pyramidal head, irregular in old age; bark bright cinnamon-red, broken into irregular ridges covered with closely appressed scales; branchlets much flattened, bright green on both sides: leaves oblong-ovate, adnate, with long decurrent base, free at the apex and acuminate, glandular on the back: cones pendulous, oblong, ¾–1 inch long, light reddish-brown; scales mucronate below the apex, a third connate pair separating the 2 fertile ones; seeds oblong-lanceolate, ⅓–½ inch long. Oregon to western Nevada and Lower California.—Introduced to Europe in 1853. Hardy as far north as Massachusetts in sheltered positions. A

handsome Thuja-like tree of narrow-pyramidal or columnar habit with deep green lustrous foliage, the upper branchlet-systems in vertical planes. A few garden forms are cultivated in Europe.

The following species are occasionally seen in European collections, but are apparently unknown in American gardens; they are all tender and could be grown only in the Southern States and California; *L. chilensis* may be somewhat hardier than the others.

L. chilensis, Endl. CHILEAN I. Tree to 60 feet tall, with compact pyramidal head; branchlets much compressed: facial leaves minute, obtuse, glandular, the lateral ones much larger, boat-shaped, keeled, acute and spreading at apex, with a silvery line beneath: cones ovate-oblong, ½ inch long. Chile. —Introduced in 1847 to Great Britain.

L. cupressoides, Sarg. (*L. tetragona,* Endl.). Tree to 100 feet tall, with compact pyramidal head, sometimes shrubby; branchlets almost tetragonal: leaves all alike, spreading, ovate or ovate-lanceolate, acute or obtuse, $\frac{1}{16}$ inch long: cones ovate; scales with a large curved spine on the back. Chile to Patagonia.—Introduced in 1849 to Great Britain.

L. macrolepis, Benth. & Hook. Tree to 100 feet tall; branchlets compressed, glaucous below with white markings: leaves of equal length, acute, the lateral strongly keeled, the facial ones obovate, apiculate: cones obovate-oblong, about ¾ inch long, consisting of 6 truncate scales. Southwestern China, Formosa.—Introduced to Great Britain in 1899.

L. plumosa, Sarg. (*L. Doniana,* Endl.). Tree to 100 feet tall, with dense pyramidal head; branchlets much compressed: facial leaves ovate, acute, scarcely glandular, lateral leaves longer, spreading and acute at apex, with a white band below: cone about ½ inch long; scales 4, with a large curved spine on the back. New Zealand.—Introduced to Great Britain in 1847.

A related genus not in cultivation in this country is **Fokienia**; it is intermediate in its characters between Chamæcyparis and Libocedrus, resembling the latter in the foliage and in the seeds having 2 very unequal lateral wings; the cone is subglobose and composed of numerous peltate scales, each bearing 2 seeds.—Two species in southeastern China. **F. Hodginsii,** Henry & Thomas (*Cupressus Hodginsii,* Dunn). Tree to 40 feet; branchlets much flattened: the lateral leaves with spreading acute apex, green above and with white markings below: cone 1 inch across, ripening the second year.—Introduced into England in 1909 by Captain Hodgins.

6. THUJA, L. ARBOR-VITÆ

Evergreen aromatic trees with thin scaly bark and short branches; the flattened branchlets arranged frond-like: leaves decussate, scale-like, appressed, usually glandular on the back: flowers monœcious, globose, small,

terminal on short branchlets; staminate yellow and consisting of 6–12 decussate stamens each with 2–4 anther-cells; fertile flowers consisting of 8–12 scales in opposite pairs, of which only the middle ones, or in the section Biota the lower ones, are fertile, each scale with 2 ovules inside at the base: cones globose-ovoid to oval-oblong; scales with a thickened ridge or umbo at the apex; seeds 2 or 3 under each scale, thin with broad lateral wings or thick and wingless; cotyledons 2. (Name derived from Greek *thya* or *thyia*, a resinous tree.) Also spelled Thuya, Thuia, or Thya.—The genus contains six species in North America and in central and eastern Asia. Except *T. sutchuenensis*, Franch., from western China, the species are in cultivation and their numerous garden forms are much planted for ornament.

A. Branchlets in horizontal planes: cone-scales thin; seeds thin, winged. (Subgenus Euthuja.)
  B. Leaves of primary axes widely spaced, ending in a long point parallel to the axis.
    C. Primary axis flattened: leaves conspicuously glandular, yellowish- or bluish-green below.....1. *T. occidentalis*
    CC. Primary axis nearly terete: leaves not or inconspicuously glandular, usually with whitish markings beneath.....2. *T. plicata*
  BB. Leaves of primary axes close, ending in a short, rigid, spreading point: young branchlets with more or less conspicuous white markings below.
    C. Under side of leaves slightly or not concave, glandless: branchlets thickish, compressed, but scarcely flattened..3. *T. Standishii*
    CC. Under side of leaves concave or grooved below, with conspicuous white markings, glandular: branchlets much flattened.....4. *T. koraiensis*
AA. Branchlets in vertical planes, bright green on both sides: cone-scales thick; seeds ellipsoidal, wingless. (Subgenus Biota.)....5. *T. orientalis*

45. Thuja occidentalis.

1. T. occidentalis, L. American Arbor-vitæ. Erroneously but commonly called White Cedar (which is properly Chamæcyparis). Fig. 45. Tree attaining 60 feet and more, with short horizontal branches ascending at the end and forming a narrow, pyramidal, rather compact head; bark light red-brown, shallowly fissured into narrow connected ridges covered with elongated scales: leaves ovate, acute, or apiculate, usually glandular, bright green above, yellowish-green beneath, changing in winter usually to dull brownish-green:

cones oval to oval-oblong, about ½ inch long, brownish-yellow, with usually 2 pairs of fertile scales; seeds ⅛ inch long. Nova Scotia to Manitoba, south to North Carolina, Tennessee, and Illinois.—Introduced to France about 1550. Hardy as far north as Canada and in sheltered positions even in Manitoba. More than 50 garden forms are known; they are favorite evergreens, particularly in colder regions, while the type is used for hedges and shelter plantations.

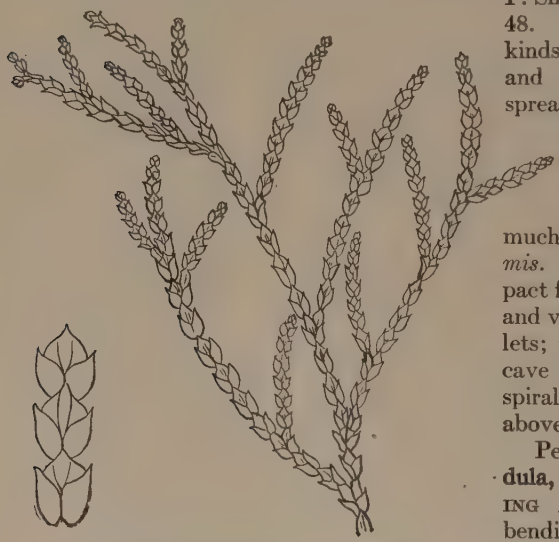
Forms distinguished by color: Var. **alba,** Nichols. (var. *albo-spica,* Beiss. var. Queen Victoria, Hort.). Queen Victoria A. Tips of young branchlets white. Var. **argentea,** Carr. (var. *albo-variegata,* Beiss.). Branchlets variegated silvery-white. Var. **Vervæneana,** Henk. & Hochst. Vervæne A. Of smaller and denser habit than the type; branchlets slenderer, with yellowish foliage, bronzy in winter. Var. **"Douglasii aurea,"** Hort. Douglas Golden A. A vigorously growing form with bronzy-yellow foliage. Var. **semperaurea,** Hort. A vigorous form with golden-yellow foliage. Var. **Columbia,** Hort. Columbia A. Plate XX. Strong habit; foliage broad, with a beautiful silvery variegation. Var. **lutea,** Gord. (var. *elegantissima,* Hort. var. "George Peabody Golden"). George Peabody A. Pyramidal form, with bright yellow foliage. Var. **aurea,** Nichols. Broad bushy form, with deep yellow foliage; also Meehan's Golden has yellow foliage. Var. **lutescens,** Hesse (var. *Wareana lutescens,* Hesse). A form of var. *robusta* with bright or dark yellow foliage. Var. **aureo-variegata,** Beiss. (var. *aurea maculata,* Hort. var. *Wareana aurea,* Hort.). Goldspot A. Foliage variegated with golden-yellow.

Pyramidal or fastigiate forms: Var. **robusta,** Carr. (var. *Wareana,* Beiss. *T. caucasica, T. tatarica,* and *T. sibirica,* Hort.). Siberian A. Pyramidal tree, lower and denser than the type, with stouter branchlets; foliage bright green. Very desirable form. Var. **Riversi,** Beiss. Rivers A. Compact pyramidal form with yellowish-green foliage. Var. **plicata,** Mast. (*T. plicata,* Parl., not Don. *T. Wareana,* Booth). Moss A. Pyramidal tree, darker and denser than the type; branchlets short, rigid, much flattened: foliage distinctly glandular, brownish dark green above, bluish-green beneath. Var. **theodonensis,** Beiss. (var. *magnifica,* Hort.). Vigorous form of upright habit with broad thickish branchlets and dark green foliage. Var. **fastigiata,** Jaeger (var. *pyramidalis,* Hort. var. *columnaris,* Hort.). American Pyramidal A. Columnar form with short branches. Var. **viridis,** Beiss. (var. *erecta viridis,* Hort.). American Green A. Compact pyramidal form with upright branches and dark green lustrous foliage. Var. **Rosenthali,** Ohlend. Rosenthal A. Columnar form with dark green lustrous foliage. **"Douglasii pyramidalis,"** Spaeth. Douglas Pyramidal A. Dense pyramidal form with short, densely branched, fern-like branches often cristate at the ends. Var. **filicoides,** Beiss. Fernleaf A. Densely branched, narrow, pyramidal form with the ultimate branchlets short and regularly pinnately arranged. Var.

Buchanani, Parsons (var. *Buchononi,* Spaeth). Plate XX. Graceful narrow-pyramidal form with slender branches and rather remote and irregularly arranged thin branchlets clothed with grayish-green foliage. A very distinct form.

Globose or dwarf forms: Var. **globosa,** Beiss. (var. *compacta globosa,* Hort.). American Globe A. Dwarf globose form, similar to var. *compacta,* but lower and smaller. Var. **Hoveyi,** Veitch. Hovey A. Dwarf, dense, ovate-globose form with bright green foliage. Var. **compacta,** Beiss. (var. *Froebelii,* Hort. var. *globularis,* Hort.). Parsons A. Globose light green form with rather thin branchlets. Var. **intermedia,** Hort. Halfhigh A. Of dwarf compact habit. Var. **Woodwardii,** Hort. Woodward A. Plate XXI. Dense globose form, with deep green foliage. Var. **Little Gem,** Hort. Little Gem A. Very dwarf dark green form, growing broader than high. Var. **umbraculifera,** Beiss. Compact, depressed-globose, of umbrella-like shape with dark green foliage.

Forms of irregular or abnormal habit: Var. **filiformis,** Beiss. (var. *Douglasii,* Rehd.). Threadtwig A. Fig. 46. Bushy form, with long and slender sparingly ramified branches nodding at the tips, partly 4-angled and clothed with sharply pointed leaves. A very distinct form, somewhat similar to *Chamæcyparis pisifera* var. *filifera.* Var. **Ohlendorffi,** Beiss. (var. *Spaethii,* P. Smith). Spaeth A. Figs. 47, 48. Peculiar form with two kinds of foliage; the younger and lower branchlets with spreading acicular leaves like those of var. *ericoides,* but thicker in texture; the upper branchlets slender and sparingly ramified much like those of var. *filiformis.* Var. **spiralis,** Hort. Compact form with upright branches and very close-set short branchlets; the branchlet-systems concave and twisted, suggesting a spiral arrangement if seen from above.



46. Thuja occidentalis var. filiformis.

Pendulous form: Var. **pendula,** Gord. American Weeping A. With the branches bending downward and the branchlets more tufted.

PLATE XLIII. The Torrey pine (*Pinus Torreyana*) at home, near San Diego

PLATE XLIV. American holly (*Ilex opaca*)

Juvenile forms: Var. **Ellwangeriana,** Beiss. (var. Tom Thumb). TOM THUMB A. Plate XXI. A low broad pyramid, with slender branches clothed with two kinds of foliage, adult leaves and primordial, acicular, spreading leaves; it is an intermediate form between the var. *ericoides* and the type. Var. **"Ellwangeriana aurea,"** Spaeth. Like the preceding but with yellow foliage. Var. **ericoides,** Beiss. & Hochst. (*Retinospora dubia*, Carr. *R. ericoides*, Hort., not Zucc.). HEATH RETINISPORA. Dwarf, globose or broadly pyramidal form, with slender branchlets clothed with needle-shaped, soft, spreading leaves, dull green above, grayish-green beneath and assuming a brownish tint in winter.

2. **T. plicata,** D. Don (*T. gigantea*, Nutt. *T. Menziesii*, Douglas. *T. Lobbii*, Hort.). GIANT A. Tall tree attaining 200 feet, with short horizontal branches often pendulous at the ends, forming a narrow pyramid; trunk with a much-buttressed base and clothed with cinnamon-red bark; branchlets slender, regularly and closely set: leaves bright green and glossy above, dark green beneath and with whitish triangular spots: leaves of vigorous shoots widely spaced, ending in long points parallel to axis of the lateral branchlets, acute and

47. Lower foliage of Thuja occidentalis var. Ohlendorffi.

48. Upper foliage of Thuja occidentalis, var. Ohlendorffi.

scarcely glandular: cones cylindric-ovoid, little over ½ inch long; scales 8–10, elliptic-oblong, usually the 3 middle pairs fertile; seeds winged, notched at the apex. Alaska to northern California and Montana.—Introduced in 1853 to England by Lobb. The Rocky Mountain form is hardy as far north as Massachusetts. Handsome pyramidal tree of rapid growth with bright green lustrous foliage which retains its color in winter.

Var. **atrovirens,** Sudw. (*T. gigantea atrovirens,* Beiss. *T. Lobbii* var. *atrovirens,* Hort. *T. occidentalis Vervæneana atrovirens,* Hort.). Foliage dark green.

Var. **fastigiata,** Schneid. (*T. gigantea fastigiata,* Beiss. *T. gigantea pyramidalis,* Bean). Columnar form.

Var. **pendula,** Schneid. (*T. gigantea pendula,* Beiss.). Form with slender pendulous branches.

3. **T. Standishii,** Carr. (*T. japonica,* Maxim. *Thujopsis Standishii,* Gord.). Standish A. Tree to 50 feet, with spreading or somewhat ascending branches forming a broad pyramid; bark reddish-brown, thin, separating into small scales leaving pale gray blotches; branchlets rather thick, compressed: leaves bright green above with triangular white marks below, glandless, those of the main axes with rigid free points, those of the lateral branchlets obtuse, ovate: cones ovoid, ⅓–½ inch long; scales 10–12, broad-ovate, the two middle pairs fertile; seeds 3 to each scale with narrow wings not notched at apex. Japan.—Introduced to Great Britain in 1861. Hardy as far north as Massachusetts. Handsome ornamental tree with rather broad head, quite different in habit from the preceding species.

4. **T. koraiensis,** Nakai. Korean A. Low spreading shrub, usually with decumbent branches, rarely a slender narrow-pyramidal tree to 12 feet tall, with spreading branches ascending at the ends; bark thin, scaly, chocolate-brown; branchlets much flattened: leaves of main branches triangular-ovate, acuminate, glandular, of lateral branchlets deltoid or rhombic, acutish or obtuse, glandular, bright green above, glaucous beneath: cones elliptic-ovoid, about ⅓ inch long, light brown; scales 8, those of the 2 middle fertile pairs oval to narrow-obovate; seeds with the wing emarginate at apex. Korea.—Introduced to the Arnold Arboretum in 1918 by E. H. Wilson. Probably hardy as far north as Massachusetts.

5. **T. orientalis,** L. (*Biota orientalis,* Endl.). Oriental A. Pyramidal or bushy tree branching from near the base, attaining 60 feet, with spreading and ascending branches; bark thin, separating into papery scales, reddish-brown; branchlets thin: leaves of main axes with a free rather spreading apex, those of the lateral branchlets closely appressed, rhombic-ovate, acute, bright green, with a small gland on the back: cones globose-ovate, ½–1 inch long, fleshy and bluish before ripening; usually 6 ovate scales, each with a horn-like process, the uppermost pair sterile; seeds 2 to each scale, ovoid,

brown. Northern China and Korea; in Japan, western China and central Asia only cultivated.—Introduced to Europe before 1735. Its hardiest forms are hardy as far north as Massachusetts; the typical form is a graceful pyramidal tree with slender ascending branches and hardier than most of the garden types which are much planted for ornament in the Southern States.

Forms distinguished by color: Var. **aurea,** Dauvesse. GOLDEN ORIENTAL A. Low, compact, globose shrub, golden-yellow in spring, changing to bright green. Var. **conspicua,** Berckmans (var. *aurea conspicua,* Hort.). GOLDSPINE A. More erect, the intense golden foliage partially suffused with green. Var. **beverleyensis,** Rehd. (*Thuja beverleyensis,* Hort.). A columnar form with the tips of the branchlets golden-yellow. Var. **elegantissima,** Gord. YELLOW COLUMN A. Of low columnar habit, bright yellow in spring, yellowish-green afterward. Var. **semperaurescens,** Nichols. EVERGOLDEN A. Dwarf, globose; the golden hue of the foliage remains throughout the whole year.

Forms distinguished by habit: Var. **stricta,** Loud. (*T. pyramidalis,* Ten. *Biota orientalis* var. *pyramidalis,* Endl.). ORIENTAL PYRAMIDAL A. Of pyramidal habit, with bright green foliage; one of the tallest and hardiest varieties. Var. **flagelliformis,** Jacq. (var. *pendula,* Mast. *Biota orientalis* var. *pendula,* Parl. *B. o.* var. *filiformis,* Henk. & Hochst. *T. pendula,* Lamb. *T. filiformis,* Lindl.). WEEPING ORIENTAL A. Branches pendulous, thread-like, sparingly ramified, and with the leaves wide apart and acuminate. Var. *funiculata,* Nichols., and var. *intermedia,* Carr., are forms intermediate between this variety and the juvenile form; their branchlets are pendent and the leaves partly scale-like and partly acicular. Var. **Sieboldii,** Endl. (var. *japonica,* Sieb. var. *nana,* Carr. var. *Zuccariniana,* Veitch. var. *compacta,* Beiss.). SIEBOLD A. Globose, compact, low form, bright green.

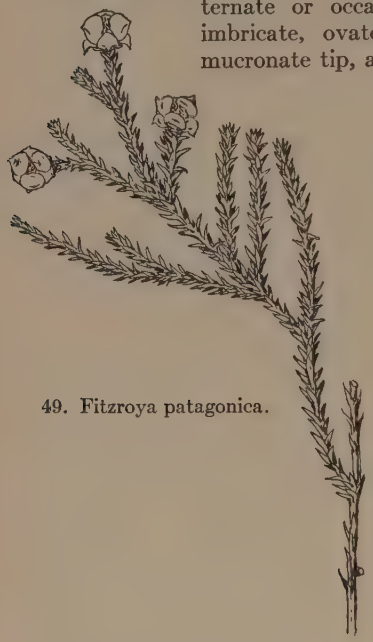
Juvenile forms: Var. **meldensis,** Mast. Of columnar, pyramidal, somewhat irregular growth: leaves acicular, bluish-green, sometimes passing into the normal form. Intermediate between the var. *decussata* and the type. Var. **decussata,** Mast. (*Biota o.* var. *decussata,* Beiss. & Hochst. *Retinospora juniperoides,* Carr. *Chamæcyparis decussata,* Hort.). Dwarf globose form: leaves linear-lanceolate, spreading, stiff, acute, bluish-green. A juvenile form.

7. FITZROYA, Hook. f. FITZROYA

Evergreen tree; ramification of branchlets irregular; branchlets angled: leaves ternate, decurrent, their free part spreading: flowers diœcious; staminate flowers cylindric, solitary, axillary, consisting of 15–24 stamens in ternate whorls: cone small, globose, with 3 ternate whorls of valvate scales, the lower whorl small and sterile, slightly imbricate, the middle whorl sterile or fertile and the upper one fertile; each fertile scale with a prominent com-

pressed umbo on back and with 2–6 2- or 3-winged seeds. (Named in honor of Captain R. Fitzroy, of the British Navy; died in 1855).—It contains only the following species:

F. patagonica, Hook. f. PATAGONIAN F. Fig. 49. Tree to 100 feet tall, in cultivation usually shrubby; bark thick, fibrous, deeply furrowed: leaves ternate or occasionally opposite, spreading or somewhat imbricate, ovate-oblong to narrow-oblong, with incurved mucronate tip, about ⅛ inch long, dark green and concave above, keeled on back, with 2 white stomatic bands beneath: cones globose, ⅓ inch across. Southern Chile.—Introduced to Great Britain by Wm. Lobb; to this country by the Biltmore Nurseries prior to 1900. It may be hardy as far north as the Middle Atlantic States in sheltered positions. In cultivation it is usually a shrub of slow growth and unsymmetrical habit, apparently without special ornamental merits.



49. Fitzroya patagonica.

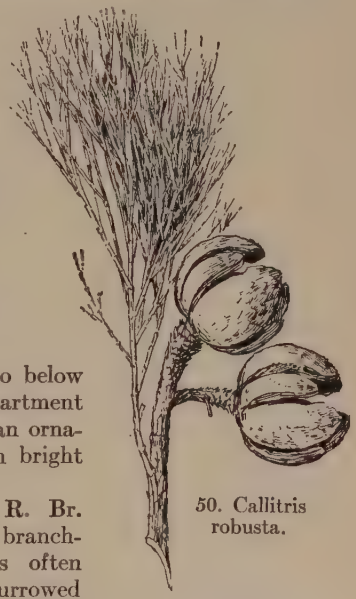
The closely related genus **Diselma,** Hook. f., differs chiefly in the cones with 2 pairs of scales, the inner scales each with 2 three-winged seeds, and in the opposite, scale-like, closely appressed leaves. The only species **D. Archeri,** Hook. f. (*Fitzroya Archeri,* Benth.), has been introduced to Great Britain, but apparently is at present no longer in cultivation.

8. **CALLITRIS,** Vent. CYPRESS-PINE; including *Octoclinis,* F. Muell.

Evergreen trees; branchlets articulate, 3- or rarely 4-angled or nearly terete: leaves in whorls of 3, or rarely 4, reduced to minute scales: flowers monœcious; staminate catkins ovoid to cylindric, the stamens in whorls of 3 or 4: cones on short and thick peduncles, without bracts at base, subglobose to oblong, usually ripening the second season; scales 6 or rarely 8, unequal, those of the outer whorl smaller; seeds many to each scale, winged; cotyledons 2, rarely 3. (Name derived from Greek *kallos,* beauty, and *tris,* thrice; referring to the ternate whorls of leaves and cones.)—About 12 species in Australia and New Caledonia.

C. robusta, R. Br. (*C. verrucosa,* R. Br. *Frenela robusta,* A. Cunn.).

Fig. 50. Tree to 100 feet tall; branchlets short and erect, often glaucous, with terete or obscurely angled internodes: scale-like leaves small and acute, ternate: staminate flowers solitary or in 3's, 1/6–1/3 inch long: cones solitary or few together, subglobose, about 1 inch across, not furrowed; valves 6, smooth on back or more or less verrucose. Australia.—Cultivated in California and Florida. Trees about forty years old are said to be growing at Santa Barbara. In southern Florida it makes good specimens, in five years becoming 10–12 feet high. The tree somewhat resembles red-cedar, and is reported as useful for tall hedges and windbreaks. This is one of the "pines" of Australia, the wood being used in building and for the making of furniture.



50. Callitris robusta.

Other species occasionally cultivated are:

C. Drummondii, F. Muell. (*Frenela Drummondii,* Parl.). Shrub or small tree; branchlets angular: cones usually solitary, globose, not furrowed, about 1/2 inch across, smooth or slightly rugose on back, with a minute mucro below the apex. Australia.—Introduced by the Department of Agriculture in 1920 and recommended as an ornamental evergreen of dwarf globose habit with bright green branchlets.

C. cupressiformis, Vent. (*C. rhomboidea,* R. Br. *Frenela rhomboidea,* Endl.). Tree to 50 feet tall; branchlets slender, angular, often drooping: cones often clustered, subglobose, about 1/2 inch across, furrowed at the junctions of the valves, the larger valves dilated into a broadly rhombical apex, with a conical process at the center and usually rugose. Australia.—Cultivated in Europe before 1890; introduced into this country by the Department of Agriculture in 1912 and 1919.

C. calcarata, R. Br. (*Frenela Endlicheri,* Parl.). Branchlets angular: cones ovoid, furrowed at junction of the valves, about 1/2 inch diameter, the larger valves little or not dilated at apex. Australia.—Cultivated in South Africa.

C. oblonga, Rich. (*C. australis,* R. Br. *Frenela Gunnii,* Endl.). Tree to 25 feet tall; branchlets angular: cones usually clustered, ovoid or oblong, 3/4–1 inch long, furrowed at the junction of the valves, the larger valves not dilated at apex, the smaller valves slightly overlapping the larger ones. Tasmania.—Introduced to Great Britain before 1890.

A related genus is **Actinostrobus,** Miq. It differs chiefly in the numerous

scale-like bracts at the base of the cone: leaves ternate, scale-like, sometimes needle-shaped: cone ripening the first year, with 6 acute valvate scales surrounding a conical production of the central axis; each scale with 2 winged seeds. The only species is **A. pyramidalis,** Miq. (*Callitris Actinostrobus,* F. Muell.), a densely branched shrub with a cone about $\frac{3}{5}$ inch across, from West Australia.—Cultivated in Europe about 1845.

51. Tetraclinis articulata.

9. TETRACLINIS, Mast. ARAR-TREE

Evergreen tree; branchlets articulate, flattened: leaves scale-like, minute, in whorls of 4: cones tetragonal, consisting of 4 valvate scales of nearly equal size, the outer pair concave on back, the inner pair depressed on back and usually sterile, all with a small mucro below the apex; fertile scales with 2 or 3 broad-winged seeds. (Name derived from Greek, *tetra,* four, and *klinis* or *kline,* bed; referring to the number and shape of the cone-scales).—One species in northern Africa.

T. articulata, Mast. (*Thuya articulata,* Vahl. *Callitris quadrivalvis,* Vent.). ARAR-TREE (SANDARACH-GUM-TREE). Fig. 51. Small tree to 20 feet tall, with slender spreading branches: the free apex of the leaves triangular, glandular: cones about $\frac{1}{2}$ inch across; scales oval. Mountains of northwestern Africa. —Introduced in 1815 to Great Britain and occasionally cultivated in European gardens and in California. It is probably not hardy north of the Southern States and California. The arar-tree has some resemblance to *Thuja orientalis,* but the habit is looser and the branchlets slenderer. It furnishes gum sandarach, a varnish resin.

10. WIDDRINGTONIA, Endl.

Evergreen trees; branchlets terete: leaves opposite, scale-like or linear, on leading shoots alternate and linear: flowers dicœcious; staminate flowers solitary and terminal: cones ripening the second year; scales 4, valvate, equal, usually tuberculate and angular on back; each scale with 1 to many winged seeds. (Named for Samuel Edward Widdrington [formerly Cook]; wrote on Conifers; died in 1856).—Five species in tropical and South Africa and Madagascar.

W. Whytei, Rendle (*Callitris Whytei*, Engl.). Figs. 52, 53. A large tree to 140 feet tall, with a straight clear trunk and very thick bark: leading shoots with spirally arranged imbricate leaves free at the apex and triangular and subpungent; ultimate branchlets with opposite closely appressed leaves deltoid and with a thickened apex; young seedling plants with linear spreading leaves to 1 inch long: cones 4–6 together on short lateral branchlets, subglobose, about ¾ inch across; scales oblong, obtuse, tuberculate on back and with a short mucro below the apex. High mountains of tropical East Africa, at 6,000–8,000 feet altitude.—Introduced in 1894 to Great Britain; cultivated in California. It is recommended for reforestation purposes in tropical and subtropical countries; its wood is dull reddish-white and strongly aromatic.

A related species is W.

52. Juvenile foliage of Widdringtonia Whytei.

53. Mature foliage of Widdringtonia Whytei.

cupressoides, Endl. (*Callitris cupressoides*, Schrad.). Shrub or small tree: leaves imbricate, scale-like: cone-scales smooth on back with an obtuse mucro below the apex and each with 5–10 winged seeds. South Africa.—Introduced to France before 1850.

11. SCIADOPITYS, Sieb. & Zucc. UMBRELLA-PINE

Evergreen tree: leaves of two kinds; small and scale-like leaves scattered on the shoot, but crowded at its end and bearing in their axils a whorl of 20–30 long, linear, flat leaves furrowed on each side, more deeply beneath; these leaves really consist each of 2 connate leaves borne on undeveloped spurs like those of Pinus; they have been sometimes called cladodes, but are not true cladodes: flowers monœcious; the staminate oval, consisting of spirally disposed 2-celled anthers and appearing in dense clusters at the ends of the shoots; the fertile ones are solitary at the ends of the shoots and consist of numerous spirally arranged scales subtended by a small bract and bearing 7–9 ovules: cone oblong-ovate, woody, ripening the second season; bracts adnate to the broadly orbicular thick scales spreading at the margin; seeds oval, compressed, with narrow wing, emarginate at the apex; cotyledons 2. (Name derived from Greek *skias*, *skiados*, umbrella, and *pitys*, pine; alluding to the position of the leaves.) —One species in Japan, with very strong and straight-grained, nearly white wood.

54. Sciadopitys verticillata.

S. verticillata, Sieb. & Zucc. UMBRELLA-PINE. Fig. 54 and Plate XXII. Tree attaining 120 feet, with short and slender, horizontally spreading branches forming a narrow, pyramidal, compact head, in old age loose; bark nearly smooth, separating in long thin shreds, gray to grayish-brown, red-brown below: scale-like leaves dark brown, 1/6 inch long; the large connate leaves 15–35 in each whorl, linear, stiff, obtuse, and emarginate, deeply furrowed on both sides, dark green and glossy above, with 2 white bands beneath, 3–6 inches long: cone 3–5 inches long, ovate-oblong; seed 1/2 inch long. Central Japan.—First successfully introduced to England in 1861 by J. G. Veitch and one year later to this country by Dr. G. R. Hall. It has proved hardy as far north as Massachusetts and is one of the handsomest and most distinct conifers. It is doing well under cultivation, but is of slow growth and forms a narrow pyramidal tree densely clothed with dark green lustrous foliage.

12. TAXODIUM, Rich. BALD-CYPRESS

Deciduous or evergreen trees or shrubs: leaves alternate, linear, usually 2-ranked, falling off in autumn or the second year together with the short lateral branchlets: flowers monœcious, small; staminate flowers catkin-like, consisting of spirally arranged anthers, with 4–9 anther-cells and forming terminal panicles; fertile flowers solitary or in pairs at the ends of branchlets of the previous year, composed of imbricated scales bearing 2 ovules inside at the base: cone globose or nearly so, maturing the first year, consisting of spirally arranged woody scales enlarged at the apex into an irregularly 4-sided disk with a mucro in the middle and narrowed toward the base into a slender stalk; 2 triangular, winged seeds under each scale; cotyledons 4–9. (The name refers to the similarity of the foliage to that of *Taxus*.)—One species in eastern North America and one in Mexico.

A. Foliage deciduous.....1. *T. distichum*
AA. Foliage persistent.....2. *T. mucronatum*

1. T. distichum, Rich. (*Cupressus disticha*, L. *Schubertia disticha*, Mirbel). COMMON BALD-CYPRESS (DECIDUOUS CYPRESS). Fig. 55. Tall deciduous tree, becoming 150 feet high, with a buttressed trunk usually 4–5, but sometimes attaining 12 feet or more in diameter, usually hollow in old age; bark light cinnamon-brown, shallowly fissured into broad flat ridges covered with long fibrous scales; branches erect or spreading, distichously ramified, forming a pyramidal head, becoming at maturity broad and rounded, with slightly pendulous branches: leaves narrowly linear, acute, thin, light green, 1/2–3/4 inch long: panicles of the purplish staminate flowers 4–5 inches long: cone almost globose, rugose, about 1 inch across and destitute of mucros at maturity, seed 1/4 inch long. Flowering in spring. Delaware to Florida, west to

southern Illinois, Oklahoma, and Texas, in swamps, along the larger rivers and over calcareous rocks.—Introduced about 1640 to Great Britain. Hardy as far north as Massachusetts. A handsome pyramidal tree with a feathery head of light green foliage; in old age sometimes wide-spreading with pendent branches.

55. Taxodium distichum.

Var. **pyramidalis,** Carr. Narrow pyramidal form with short ascending branches.

Var. **nutans,** Loud. Branches spreading, long and slender, nodding at the tips.

Var. **imbricarium,** Sarg. (*T. adscendens,* Brongn. *T. imbricarium,* Harper. *T. microphyllum,* Brongn. *T. distichum* var. *erectifrons,* Schelle). POND-CYPRESS. Smaller tree with deeply furrowed bark; branches upright: leaves subulate, $\frac{1}{8}$–$\frac{1}{2}$ inch long, more or less upright and rather appressed. Virginia to Florida and Alabama. —In cultivation in England before 1879. By some botanists this is considered a distinct species, but it is apparently only a variety due to certain soil conditions; it occurs in lakes, ponds, and small rivers, apparently always over a clay subsoil.

Var. **pendulum,** Carr. (*T. distichum sinense pendulum,* Loud. *Glyptostrobus pendulus,* Endl. *G. sinensis,* Hort.). WEEPING POND-CYPRESS. A form of the preceding variety with pendulous branches.

2. **T. mucronatum,** Ten. (*T. mexicanum,* Carr. *T. distichum* var. *mexicanum,* Gord. *T. distichum* var. *mucronatum,* Henry). MONTEZUMA CYPRESS. Similar to the preceding species: taller evergreen tree, occasionally 170 feet high with a trunk 20 feet or more in diameter: leaves shorter, obtusish and mucronulate, falling with the branchlet the second year: staminate panicles and cones larger. Flowering in autumn.—Introduced to Italy in 1838 and occasionally cultivated in California.

The closely related Chinese genus **Glyptostrobus** is often united with Taxodium, but it differs in its elongated not peltate cone-scales. The only

species is **G. sinensis,** Henry (*G. heterophylla,* Endl. *Taxodium heterophyllum,* Brongn.). A small tree with dimorphic deciduous leaves linear and arranged in 3 ranks on sterile branches, imbricate and scale-like on fertile ones: cones pyriform, about ¾ inch long. Southeastern China.—Introduced to Great Britain in 1804, but apparently unknown in this country.

13. SEQUOIA, Endl.

Large evergreen trees with thick, red, fibrous and deeply grooved bark; heartwood dark red, soft, durable, straight-grained; sapwood thin and nearly white: leaves persistent, alternate, linear or awl-shaped or scale-like, often dimorphic: flowers monœcious; staminate catkins axillary and terminal, each of the numerous spirally arranged stamens bearing 2–5 pollen-sacs; fertile catkins terminal, composed of many spirally arranged scales, each with 4–7 ovules at base: cone woody, persistent, the divergent scales widened at summit which is rhomboidal, wrinkled, and with a depressed center; seeds flattened, winged; cotyledons 4–6. (Named after Sequoyah, a Cherokee half-breed of Georgia, originator of the Cherokee alphabet; about 1770–1843.) —Two species in western North America.

A. Leaves mostly spreading in 2 ranks: buds scaly . . . . . 1. *S. sempervirens*
AA. Leaves appressed or slightly spreading, not 2-ranked: buds naked . . . . . 2. *S. gigantea*

1. S. sempervirens, Endl. Redwood. Fig. 56 and Plate XXIII. Tree 100 to 340 feet high, with trunk 10–25 feet in diameter and often clear of limbs for 100 feet in mature specimens, the narrow crown with horizontal or downward-sweeping branches; bark dark brown, 6–12 inches thick, divided into rounded ridges covered with long and narrow fibrous scales, in falling disclosing the light cinnamon-red inner bark: leaves linear, mostly ½–1 inch long, 1–1¼ lines wide, spreading in flat sprays, or the upper leaves and those on main stems of the branches often only 1–5 lines long and awl-shaped: cone oval, ¾–1⅛ inches

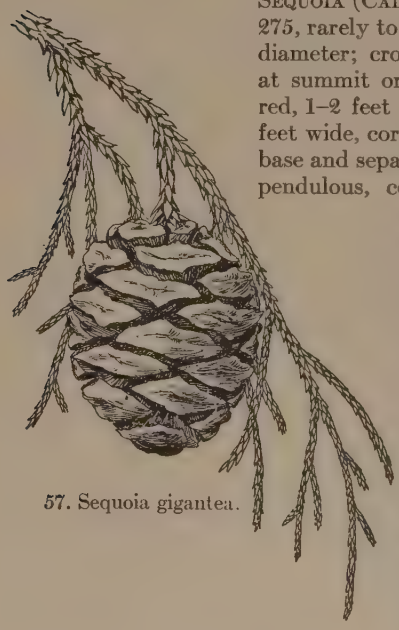
56. Sequoia sempervirens.

long, ½–¾ inch broad, maturing the first autumn; scales 14–26; seeds elliptic, narrowly margined, 2 lines long. Confined to northern and central Coast Ranges of southern Oregon and northern California.—Introduced to Great Britain about 1848 by Hartweg. In the East it is probably not hardy north of Virginia. It is a handsome tree with spreading branches and yew-like dark green foliage. It holds the record as the tallest tree in the world, at least so far as actual measurements have been made, one specimen in Humboldt County, California, measuring 340 feet, according to Sargent. Greater heights assigned to species of Eucalyptus were erroneous. It reproduces by seeds and by stump-sprouts, the latter numerous and remarkably persistent, often producing merchantable lumber.

Var. **adpressa,** Carr. (var. *albo-spica*, Hort.). Smaller tree with shorter branches: leaves shorter and broader, slightly appressed; young leaves and tips of branchlets creamy-white, glaucescent when older.

Var. **glauca,** R. Smith. Blue Redwood. Foliage with a decidedly bluish cast.

2. **S. gigantea,** DC. (*S. Washingtonia*, Sudw. *S. Wellingtonia*, Seem. *Wellingtonia gigantea*, Lindl. *Washingtonia californica*, Winslow). Giant Sequoia (California Big Tree). Fig. 57. Tree 150–275, rarely to 325 feet high, with trunk 10–30 feet in diameter; crown pyramidal on young trees, rounded at summit or much broken in age; bark cinnamon-red, 1–2 feet thick, divided into rounded ridges 4–5 feet wide, corresponding to the lobes of the buttressed base and separating into loose fibrous scales; branches pendulous, cord-like: leaves scale-like, ⅛–½ inch long, sharp-pointed, adherent to the stem which they thickly clothe, the tip free: cone ovoid, 2–3¾ inches long, 1½–2 inches broad, opening only slightly, maturing the second summer, persistent; scales 25–45; seeds oblong or somewhat ovate, wing-margined, 2½–3 lines long. Western slopes of Sierra Nevada, California.—Introduced in 1853 by Wm. Lobb to Great Britain. In the East it is not reliably hardy north of Philadelphia, although in southern and western New York trees have occasionally reached a fair size and in the neighborhood of Boston have survived ordinary winters for a number



57. Sequoia gigantea.

of years. As usually seen in cultivation, it is a handsome narrow-pyramidal tree clothed to the ground with short and slender upcurved branches, but in mature specimens the trunk is clear of limbs up to 80 to 200 feet. It is the most massive of all trees, although exceeded in girth by a few others, notably the African baobab. In nature it reproduces only by seeds and does not make stump-sprouts as the preceding species.

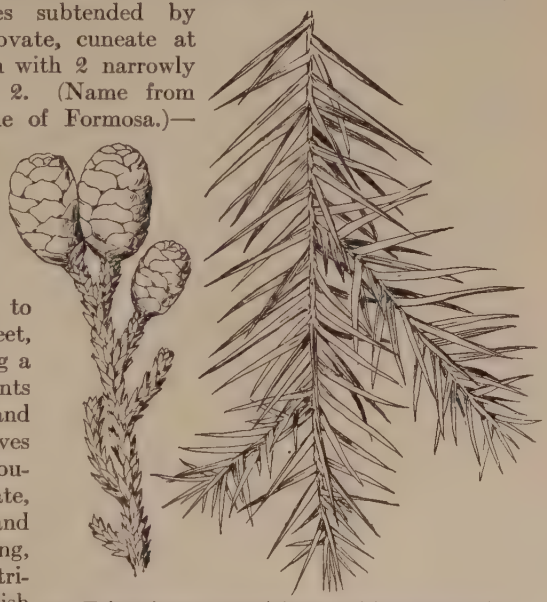
Var. **pendula,** Lav. Weeping Giant Sequoia. A form in which the branches are strongly recurved, closely covering the stem and producing a narrow cylindric effect similar to that of Italian cypress.

There is a form with bluish foliage, var. **glauca,** Otto, Blue Giant Sequoia, and a form with yellow foliage, var. **aurea,** Nichols ; also insignificant variegated forms.

14. TAIWANIA, Hayata. TAIWANIA

Evergreen tree: leaves dimorphic, alternate, subulate, falcate, 4-angled, or on fruiting branches scale-like, imbricate, incurved: scales of pistillate flowers with 2 reversed ovules: cones terminal, subglobose, with many spirally arranged imbricate scales subtended by minute bracts; scales obovate, cuneate at base, mucronate, thin, each with 2 narrowly winged seeds; cotyledons 2. (Name from Taiwan, the Chinese name of Formosa.)—One species in Formosa and western China.

T. cryptomerioides, Hayata. Fig. 58. Tree to 200 feet high with a tall clean trunk sometimes 30 feet in girth and clean to the height of 100 or 150 feet, with short branches forming a small crown; young plants with ascending branches and pendulous branchlets: leaves of sterile branches linear-subulate, pungent, incurved-falcate, keeled on the ventral and dorsal side, about ½ inch long, those of fertile branches triangular, imbricate, obtusish or acutish, about ⅛–⅕ inch



58. Taiwania cryptomerioides. Fruiting branch with adult foliage and branchlet with juvenile foliage.

long: cone about ½ inch long with about 15 leathery scales; seeds oblong, with the wing about ¼ inch long. High mountains of Formosa and southwestern China.—Introduced to the Arnold Arboretum in 1918 by E. H. Wilson; young plants are growing in California and Florida. When young it is a very handsome tree of broad-pyramidal outline with ascending branches and long pendulous branchlets; the foliage is very similar to that of Cryptomeria.

59. Athrotaxis selaginoides.

15. ATHROTAXIS, D. Don.

Evergreen densely branched trees; bark peeling off in longitudinal shreds: leaves homomorphic, small, alternate or indistinctly decussate, either short, blunt, scale-like and appressed, or lanceolate and somewhat loosely disposed: flowers monœcious; staminate flowers in imbricated spiral aments, the anthers 2-celled; fertile flowers in spirally imbricated aments, 3–6 ovules under each scale, these aments becoming small globular cones with woody scales which are contracted at base and at apex peltately dilated or pointed; seeds 3–6, winged; cotyledons 2. (Name derived from Greek *athroos*, crowded, and *taxis*, arrangement; alluding to the crowded cone-scales and leaves.)—Three species in Tasmania. One or the other of these species which were introduced to Great Britain in 1857 by Wm. Archer may be in cultivation in this country either in the open in the Southern States or in California or as a greenhouse plant in the North.

A. Leaves lanceolate or ovate-lanceolate.
  B. Cone-scales without process on back: leaves spiny-pointed...1. *A. selaginoides*
  BB. Cone-scales with large acute process on back: leaves obtuse or acute.....2. *A. laxifolia*
AA. Leaves rhombic-ovate, obtuse.....3. *A. cupressoides*

1. A. selaginoides, D. Don (*A. alpina*, Van Houtte. *Cunninghamia selaginoides*, Zucc.). Fig. 59. Tree to 100 feet tall, with fibrous slightly furrowed bark: leaves spreading, lanceolate, incurved, acute, rigid and spiny pointed, ⅓–½ inch long, with 2 glaucous bands on the ventral side, keeled on back and with 2 small glaucous depressions; those of young seedlings narrower: cones ¾–1 inch diameter, the scales numerous, broad-ovate, acuminate.

2. A. laxifolia, Hook. (*A. Doniana*, Henk. & Hochst.). Tree to 40 feet tall: leaves slightly spreading, ovate-lanceolate, obtuse or acute, about ¼ inch long, with translucent entire margin, on the ventral side with glaucous

stomatic bands, on the back with whitish depressions near the base: cones ¾ inch across, the scales thickened, with a large acute process on back.

3. **A. cupressoides,** D. Don (*A. imbricata,* Maule. *Cunninghamia cupressoides,* Zucc.). Tree reaching 40 feet, with ascending branches: leaves rhombic-ovate, broad and obtuse, with translucent denticulate margin, ⅛–⅙ inch long, thick and keeled, closely appressed to the branches: cones ⅜–½ inch across, the scales rounded at top and bearing a triangular recurved process in the middle.

16. CRYPTOMERIA, D. Don. CRYPTOMERIA

Evergreen pyramidal tree with a straight slender trunk covered with reddish-brown bark, and with irregularly whorled spreading branches ascending at the extremities: leaves spirally arranged, linear-subulate, acute, slightly curved, decurrent at the base: flowers monœcious; staminate flowers axillary, oblong, yellow, forming short racemes at the end of the branches; pistillate globular, solitary, at the end of short branchlets: cone globular, with thick, wedge-shaped scales, furnished with the recurved point of the adnate bract on the back and with pointed processes at the apex, each scale with 3–5 narrow-winged, erect seeds; cotyledons usually 3, rarely 2. (Name derived from Greek *kryptos,* hidden, and *meros,* part; meaning doubtful.)—Only one species is known.

60. Cryptomeria japonica.

C. japonica, D. Don. Common C. Fig. 60. Tree attaining 125 feet in height; bark cinnamon-brown peeling off in long ribbon-like shreds: leaves linear-subulate, compressed and slightly 4- or 3-angled, bluntly keeled on the dorsal and sharply keeled on the ventral side, bluish-green, ½–1 inch long: cone brownish-red, ¾–1 inch across. In central and southern Japan and doubtfully native to China.—It is much planted in Japan and China as an ornamental and as timber trees in the former country, where the light and easily worked but durable wood is much used. It was first introduced in its Chinese form to Great Britain in 1842 and perhaps a few years earlier to Petrograd. It has proved hardy as far north as New York and in sheltered positions in the neighborhood of Boston.

The type has been distinguished as var. *japonica,* Henry. A pyramidal tree with straight spreading branches and short, stout, dark green leaves: cone-

scales with long-acuminate processes and long-pointed bracts, making the cone very spiny.—Introduced in 1861 by Siebold to Holland.

Var. **Lobbii,** Carr. Lobb C. Similar to the preceding, of more compact habit, with more appressed dark green leaves and the cones with the processes and the bracts even longer.—Introduced in 1845 by Wm. Lobb from Buitenzorg, Java.

Var. **sinensis,** Sieb. & Zucc. (var. *Fortunei,* Henry. *C. Fortunei,* Hooibrenk). Tree of more diffuse habit, with slenderer branches, deflexed branchlets and longer and slenderer leaves: cones with fewer scales which have shorter processes and shorter tips of scales. This was the first of the forms introduced into cultivation, as stated under the species. It is somewhat tenderer than the Japanese type.

Var. **compacta,** Beiss. Cave C. Of very compact habit, with bluish-green foliage.

Var. **nana,** Carr. Dwarf and procumbent, densely branched form; adapted for rockeries.

Var. **araucarioides,** Henk. & Hochst. Branches deflexed with long, distantly placed, pendulous branchlets: leaves small, stout and stiff, incurved at apex, bright green.

Var. **dacrydioides,** Carr. With long, distant branches, close, somewhat pendent branchlets, and short, very closely set leaves of brownish color.

Var. **pungens,** Carr. Prickly C. Compact form with spreading, rigid, and sharply pointed much-compressed leaves of bluish-green color.

Var. **cristata,** Beiss. (var. *Lobbii cristata,* Hort.). Monstrous form with fasciated coxcomb-like branches, with occasional normal branches.

Var. **spiralis,** Sieb. & Zucc. Slender shrub, with strongly falcate leaves, twisted spirally around the branchlets.

Var. **elegans,** Mast. (*C. elegans,* Veitch). Spreading C. Plate XXIV. Low dense tree, with horizontal branches and pendulous branchlets: leaves linear, flattened, soft, spreading, longer than in the type, bright green, changing to bronzy red in fall and winter. Very handsome when young, but short-lived.—Introduced in 1861 to Great Britain and in 1862 to this country by Dr. G. R. Hall.

17. CUNNINGHAMIA, R. Br. CHINA-FIR

Evergreen trees with whorled spreading branches distichously ramified with opposite branchlets; without distinct winter-buds: leaves linear-lanceolate, rigid, densely spirally arranged and 2-rowed in direction: flowers monœcious; staminate oblong, fertile globose, both sexes in small clusters at the end of the branches: cones roundish-ovate, 1–2 inches long, with roundish-ovate, serrate and pointed, coriaceous scales, each with 3 narrow-winged seeds at the base; cotyledons 2. (Named in honor of J. Cunningham who

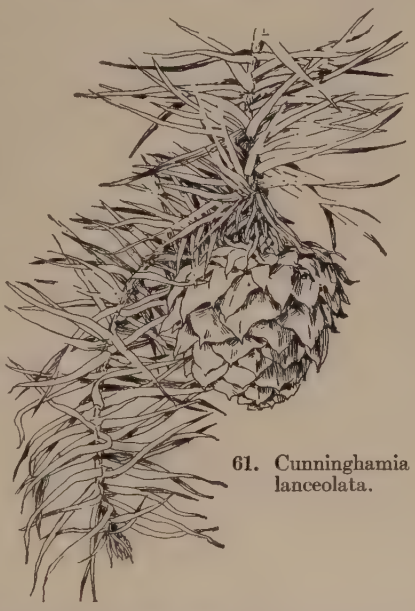
PLATE XLV. The autumn beauty of rhododendrons.—Seen before the sun was on them

PLATE XLVI. The bloom of rhododendrons, with backgrounds of conifers

discovered this tree in China in 1702.)—Two species in southern and western China and in Formosa.

A. Leaves of fertile branches spiny-pointed, 1–2 inches long: cones about 1½ inches long ..... 1. *C lanceolata*
AA. Leaves of fertile branches obtusish, ½–¾ inch long: cone about ¾ inch long ..... 2. *C. Konishii*

1. C. lanceolata, Hook. (*C. sinensis*, R. Br.). Fig. 61. Tree attaining 80 feet in height: leaves linear-lanceolate, with broad decurrent base, sharply pointed, finely serrulate, light green and shining above and with 2 broad whitish bands beneath, 1½–2½ inches long: cones 1–2 inches long. Southern, central, and western China.—Introduced to Great Britain in 1804 by Wm. Kerr and again in 1844 by Fortune. Hardy as far north as Pennsylvania in sheltered positions but injured in very severe winters. Handsome tree with horizontally spreading branches pendulous at the extremities. If cut down or killed back by frost, it sprouts from the stump and forms bushy specimens.



61. Cunninghamia lanceolata.

2. C. Konishii, Hayata. Tree to 100 feet, with longitudinally furrowed cinnamon-brown bark becoming grayish-white with age: leaves on fertile shoots lanceolate, falcate, obtusish, ½–1 inch long, grayish-green with 2 broad white bands beneath and 2 narrow stomatic bands above, on young plants linear-lanceolate, to 1½ inches long, spiny-pointed and without stomatic lines above: cones ovoid, ¾–1 inch long; scales rounded with a sharp mucro at the apex. Formosa.—Introduced to the Arnold Arboretum by E. H. Wilson in 1918 and growing well in California and Florida. Young plants differ little from those of the preceding species.

18. ARAUCARIA, Juss. (Synonym: *Dombeya*, Lam.). ARAUCARIA

Evergreen tall trees with regularly whorled branches; without distinct winter-buds: leaves spirally arranged, subulate or scale-like and stiff, clothing

all the branches uniformly and usually closely imbricated: flowers mostly dicœcious, the staminate terminal and solitary or disposed in fascicles; anthers 6–8-celled; fertile flowers in ovoid or globose heads that become large woody cones with only 1 seed underneath each scale; scales numerous, elongated, cuneate, 2-edged or 2-winged; seeds wingless, adnate to the scale at the base; cotyledons 2–4. (Name derived from Arauco, a province of southern Chile where one of the species grows.)—About twelve species in South America, Australia, and the Pacific Islands to New Guinea. They are stately ornamental trees in subtropical countries, while in colder regions they are in their juvenile state favorite greenhouse and pot-plants.

A. Leaves flattened, sharply pointed, ¾–2 inches long, homomorphic: cone-scales not winged; cotyledons 2, hypogean (remaining below ground). Sect. COLYMBEA, Endl.
  B. Arrangement of leaves spreading in two ranks, contracted at base.....1. *A. Bidwillii*
  BB. Arrangement of leaves imbricated, crowded, broad at base.
    C. Shape of leaves lanceolate, loosely imbricated, glaucous green.....2. *A. brasiliana*
    CC. Shape of leaves ovate-lanceolate, to ¾ inch broad at base, densely imbricated, bright green on both sides...3. *A. araucana*
AA. Leaves subulate or flattened and obtusish, not more than ½ inch long, more or less dimorphic, those of fertile branches much shorter, compressed, obtusish and densely imbricate: cone-scales winged; cotyledons 4, epigean (above ground). Sect. EUTACTA, Endl. (*Eutassa*, Salisb. *Eutacta*, Link).
  B. Form of leaves flattened, oblong-lanceolate or elliptic, obtusish, densely imbricated, at least $\frac{1}{12}$ inch wide.....4. *A. Rulei*
  BB. Form of leaves (of sterile branches) subulate or linear-lanceolate, about $\frac{1}{24}$ inch thick.
    C. Leaf mucronate, not spiny, slightly or not keeled on the ventral side, triangular, falcate.
      D. Position of leaves loosely appressed and imbricate, broad at base and slightly decurrent, about ¼ inch long.....5. *A. Cookii*
      DD. Position of leaves spreading, laterally compressed, decurrent, ⅓–½ inch long.....6. *A. excelsa*
    CC. Leaf spiny-pointed, rigid, much flattened, strongly keeled on both sides, quadrangular, scarcely falcate...7. *A. Cunninghamii*

1. A. Bidwillii, Hook. BUNYA-BUNYA. Tree attaining 150 feet in height, the trunk free of branches for about half its height; branches in whorls of 10–15, sparingly ramified: leaves in two rows, lance-ovate and very sharp-pointed, ¾–1½ inches long, thick, firm and shining: staminate flowers 2–3 inches long: cone globose-ovoid, about 9 inches long and 7 inches through; scales terminating in an acute edge. Australia.—Introduced about 1840. A handsome and graceful species.

2. A. brasiliana, A. Rich. (*A. brasiliensis*, Loud.). BRAZILIAN A. Tree

to 100 feet tall, with spreading and slightly pendent branches raised at the ends, in whorls of 5–7, with the branchlets and leaves tufted at the ends, tending to disappear below as the plant grows: leaves oblong-lanceolate, 1–2 inches long, somewhat decurrent, much attenuated and very sharp-pointed, deep glaucous green, loosely imbricated: staminate flowers 4–5 inches long: cones globose, 5–6 inches across; scales with a recurved spine at apex. Southern Brazil.—Introduced to Europe in 1819.

Var. **Ridolfiana**, Gord. A more robust form with longer and larger leaves.

Var. **elegans**, Laws. (var. *gracilis*, Carr.). A form with more numerous and slenderer branches and more crowded, narrower, and often glaucous leaves.

62. Araucaria araucana.

3. **A. araucana**, K. Koch (*A. imbricata*, Pav.). MONKEY-PUZZLE. Fig. 62. An unusual and striking tree of pyramidal habit, to 100 feet tall; branches generally in whorls of 5, at first horizontal, with upward-curving (sometimes downward-curving) tips, but finally becoming much deflexed; branchlets in opposite pairs, curved upward when young, and continuing to grow until several feet long when adult: leaves imbricated and persisting, even on the trunk, ovate-lanceolate, very stiff, leathery, and sharp-pointed, 2 inches long on the primary stem and branches, 1 inch long on the branchlets, slightly concave at the base, bright green on both sides: staminate flowers 3–5 inches long: cone globose-ovoid, 5–8 inches in diameter; scales with lanceolate acuminate appendage about 1 inch long at apex; seeds about 1 inch long, obscurely 4-angled. Western slope of the Andes in Chile.—A few plants were brought to England in 1795 by A. Menzies, but remained very rare until in 1844 Wm. Lobb sent a large supply of seeds. This is the hardiest species and can probably be grown as far north as the Middle Atlantic States in sheltered locations. Thrives well in mild climates in a heavy loamy soil in a moist valley or position sheltered from rough winds. The branches are heavy and rather brittle and the beauty and symmetry are soon destroyed if planted in an exposed position. One of the most distinct conifers, of singular and impressive appearance when clothed to the ground with its

whorls of regularly branched stout and heavy branches covered throughout with dark green spiny leaves.

4. **A. Rulei,** F. Muell. Tree to 60 feet tall, with the branches in whorls of 5–7; branchlets elongated, horizontal to slightly pendent or slightly ascending at the ends; leafy branchlets very long: leaves oblong-lanceolate to elliptic, imbricated, concave, arched toward the branch, nearly or quite obtuse, ½–¾ inch long, with a prominent dorsal nerve, silvery-gray on the upper and rich glossy green on the lower side. New Caledonia.—Introduced in 1863 to Great Britain. A very handsome plant of regular habit with stout branchlets and dark green foliage. Variable at different ages. When young, the branches are often drooping and the leaves compressed and obscurely 4-angled and nearly or quite subulate: var. **polymorpha,** Bailey (*Eutacta Rulei polymorpha,* Carr.).

Var. **Goldieana,** Mast. A form with more sparingly ramified erect or ascending branches and narrower leaves.

A related species rarely grown is **A. Balansæ,** Brongn. & Gris. Slow-growing plant with usually 5 slender branches in a tier: leaves imbricate, short, ovate, ⅛ inch long, stiff, falcate, obtuse, dark olive-green: cones subglobose, 4 inches long. New Caledonia.—Introduced in 1875.

5. **A. Cookii,** R. Br. (*A. columnaris,* Hook.). A slender columnar tree attaining 200 feet in height, much narrower in shape than *A. excelsa* which it closely resembles when young; branches disposed as in *A. excelsa,* but tree tending to shed the lower ones; branchlets crowded on the branches and turning upward in a boat-like form: young leaves rather closely arranged on the branchlet and ¼–⅓ inch long, broad and slightly decurrent at base, slightly curved, mucronate; adult leaves densely imbricated, short and ovate, obtuse: staminate flowers 1½ inches long: cones globose-ovoid, 4–5 inches high and 3–4 inches in diameter; scales terminating in a long subulate mucro. New Caledonia and New Hebrides.—Introduced about 1850 to Great Britain.

6. **A. excelsa,** R. Br. Norfolk-Island-Pine. Tree attaining 200 feet in height; branches frondose, in whorls of 4–7: leaves curved and sharp-pointed, rather soft, ⅓–½ inch long, and densely placed on the horizontal or drooping branchlets: cones subglobose, broadest at base, 4–6 inches across; scales terminating in an incurved spine. Norfolk Islands.—Introduced to England about 1793 by J. Banks. This is the most commonly cultivated species, being much grown as small pot-specimens. It is an excellent house plant, and keeps well in a cool room near a window. In summer it may be used on the veranda, but must be shaded.

Var. **glauca,** Carr. Bluish A. With bluish-green foliage.

Var. **albo-spica,** Mast. Silver-Star A. Tips of the young branchlets white.

Var. **robusta,** Kent. EMERALD A. A strong-growing form with deep green foliage.

Var. **virgata,** Schwerin. The primary branches without or with very short secondary branchlets.

7. **A. Cunninghamii,** Lamb. HOOP-PINE (MORETON BAY PINE). Tree attaining 200 feet in height, with spreading branches in whorls of 4–7, the upper ascending, the lower in older plants somewhat depressed: leaves acicular, straight or nearly so, stiff and pungent, ¼–½ inch long, laterally strongly compressed, with the dorsal midrib decurrent: staminate flowers 2–3 inches long: cone ovoid-globose, about 3 inches long; scales terminating in a lanceolate recurved mucro. Australia.—The most widely distributed of the Australian araucarias and a valuable timber tree. Introduced to Great Britain in 1851. It is a less formal and symmetrical plant than *A. excelsa* and not much cultivated.

Var. **glauca,** Endl. With silvery glaucous foliage.

19. AGATHIS, Salisb.
DAMMAR-PINE

Evergreen trees with whorled branches; without distinct winter-buds: leaves opposite or alternate, usually more or less 2-ranked, flat and broad, not needle-like, coriaceous: flowers diœcious; staminate flowers axillary, cylindric; fertile flowers terminal or axillary: cones usually on short lateral branchlets, globose-ovoid, usually depressed, composed of numerous broadly obovate scales without bracts; each scale with a solitary reversed winged seed; cotyledons 2. (Name derived from Greek *agathis*, ball or glome; referring to the shape of the fertile flowers and the cone.)

A. Leaves sessile, oblong to narrow-lanceolate, ⅛–¾ inch broad. . . . 1. *A. australis*

AA. Leaves short-petioled, generally oblong, ¾–1½ inches broad.

63. Agathis australis.

B. Staminate flowers ¾ inch long: leaves obtuse, usually opposite. . 2. *A. alba*
BB. Staminate flowers about 1½ inches long: leaves short-acuminate to obtuse, often alternate. . . . . 3. *A. robusta*

1. **A. australis,** Steud. (*Dammara australis,* Lamb.). KAURI-PINE. Fig. 63. Tree to 100 or occasionally to 150 feet tall; bark glaucous gray, falling off in large flakes: leaves opposite, rarely alternate, sessile, oblong or obovate-oblong, ¾–1½ inches long, obtuse, on young trees oblong to narrow-lanceolate and 2–4 inches long: staminate flowers ¾–1½ inches long, solitary: cone terminal on short branchlets, erect, subglobose, 2–3 inches across; scales terminating in a short mucro. New Zealand.—Introduced in 1821 to Great Britain. Cultivated out-of-doors in California, but not very successfully. Kauri gum, much used in the manufacture of varnish, is the partly fossilized resin of *A. australis.* It is found 5–6 feet below the surface of the ground in the northern part of New Zealand where there were vast forests of this tree in ages past.

2. **A. alba,** Foxw. (*A. loranthifolia,* Salisb. *A. Dammara,* Rich. *A. orientalis,* Rehd. *Dammara alba,* Lam. *D. orientalis,* Lamb.). WHITE D. Tree to 100 feet tall: leaves usually opposite, oblong to oblong-lanceolate, obtuse, 2–4 inches long, thickish, striated, dull green: staminate flowers about ¾ inches long: cone globose-ovoid, about 3½ inches long and 2–2½ inches in diameter. Malayan Archipelago.—Introduced to Great Britain in 1804. Cultivated out-of-doors in California and in greenhouses elsewhere. Both this and the preceding species were introduced to California by Franceschi of Santa Barbara.

3. **A. robusta,** F. M. Bailey (*Dammara robusta,* C. Moore. *D. Brownii,* Lem.). ROBUST D. Tree to 150 feet tall, with nearly whorled branches: leaves ovate-lanceolate to oblong-lanceolate, obtuse to short-acuminate, 2–3, rarely to 4 inches long, striated: staminate flowers about 1½ inches long: cone globose-ovoid to obovoid, 3–4 inches long; seeds nearly ½ inch long, with an upright wing as long as the seed. Australia.—Introduced to Europe before 1850. Cultivated in California.

A. obtusa, Morrison (*Dammara obtusa,* Lindl.), from the New Hebrides, is closely related. It was introduced to Europe in 1851 and is but rarely cultivated in greenhouses in Europe.

20. KETELEERIA, Carr.

Evergreen trees with rough irregularly furrowed bark and whorled spreading branches, of regular pyramidal habit while young, in old age with a broad flat-topped head; winter-buds globose or ovoid, not resinous: leaves linear, flat or keeled, not grooved above, pale green below, appearing 2-ranked: flowers monœcious, staminate arranged in clusters; anthers 2-celled; cones

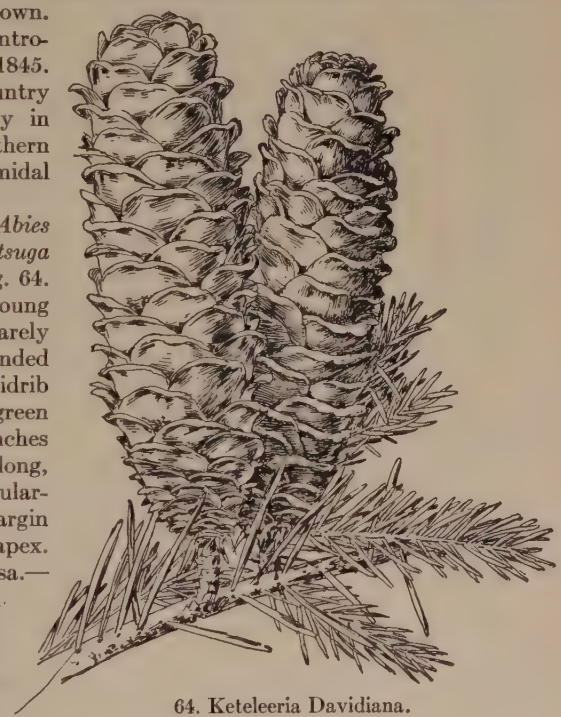
upright, with persistent woody scales; bracts inclosed, about half as long as the scales; wings of seeds as long as the scales; cotyledons 2, hypogean (remaining below ground). (Named in honor of Jean Baptiste Keteleer, a French nurseryman, born in Belgium.)—Two or possibly 3 or 4 species in China and Formosa.

A. Young branchlets orange-red, glabrous: cone-scales suborbicular, slightly inflexed at apex. . . . . 1. *K. Fortunei*

AA. Young branchlets yellowish-gray, puberulous or sometimes glabrous: cone-scales ovate, recurved at apex . . . . . 2. *K. Davidiana*

1. **K. Fortunei,** Carr. (*Abies Fortunei,* Murr. *Pseudotsuga jezoensis,* Bertrand. *Pinus Fortunei,* Parl. *Abietia Fortunei,* Kent). Tall tree to 100 feet; branchlets glabrous, orange-red: leaves linear, rigid, mucronate or spiny-pointed, obtusish on old trees, flat, with the midrib prominent on both sides, glossy dark green above, paler below, 1–1¼ inches long: cones ovoid or cylindric-ovoid, 3–7 inches long; scales suborbicular, purple while young, later reddish-brown. Southeastern China.—Introduced to Europe about 1845. Little known in this country and probably hardy only in California and the Southern States. Handsome pyramidal tree similar to a fir.

2. **K. Davidiana,** Beiss. (*Abies Davidiana,* Franch. *Pseudotsuga Davidiana,* Bertrand). Fig. 64. Tall tree to 120 feet; young branchlets puberulous, rarely glabrous: leaves linear, rounded or notched at the apex, midrib raised on both sides, glossy green above, paler below, 1–1½ inches long: cones cylindric-oblong, 6–8 inches long, with orbicular-ovate scales, erose at the margin and recurved at the apex. Western China and Formosa.—Introduced by E. H. Wilson in 1900 to Great Britain and in 1907 to the Arnold Arboretum. This species is probably somewhat har-



64. Keteleeria Davidiana.

dier than the preceding one, but has not yet been sufficiently tested. *Keteleeria sacra*, Beiss., *K. Evelyniana*, Mast., and *K. formosana*, Hayata, are probably synonyms or only varieties of *K. Davidiana*.

21. ABIES, Mill. FIR

Evergreen trees of pyramidal habit, with whorled spreading branches; bark usually smooth, thin on young trees, thick and furrowed at base of old trees; winter-buds with or without resin: leaves persistent for many years, linear to linear-lanceolate, entire, sessile, contracted above the circular base and leaving a circular scar as they fall, flattened, usually grooved and deep green and lustrous above, with 2 white or pale stomatic bands and keeled beneath, rarely 4-sided with stomata on all 4 sides, rounded and variously notched or pointed at the apex, usually appearing 2-ranked by a twist at their base, with 2 resin-canals which are either marginal (lying close to the epidermis of the under side) or internal (surrounded by the tissue of the leaf), and with 2, rarely 1, vascular bundles; on upper fertile branches crowded, more or less erect, often incurved or falcate, thickened or quadrangular, obtuse or acute: flowers axillary, appearing in early spring from buds formed the previous summer on branchlets of the year, surrounded by involucres of the enlarged scales of the flower-buds; staminate flowers pendent on branches above the middle of the tree; fertile flowers globular, ovoid or oblong, with numerous 2-ovuled imbricate scales, erect on the topmost branches: fruit an erect ovoid or oblong-cylindrical cone, its scales longer or shorter than their bracts, broad and rounded or truncate at the incurved apex, narrowed at base into a long stipe; seeds with large thin wing; cotyledons 4–10. (Abies is the ancient Latin name of the silver-fir.)—About 35 species in northern and mountainous regions of the northern hemisphere, often gregarious, extending south in America to Guatemala, in the Old World to northern Africa and the Himalayas.

The species of this genus are among the handsomest and stateliest conifers. They succeed best in a cool and humid climate and are particularly impatient of dust and smoke, therefore not suited for planting in or near cities; only a few, like *A. concolor*, are more resisting. All the known species have been introduced and are in cultivation except *A. maroccana* and *A. Kawakamii*.

The following key is artificial and based primarily on vegetative characters; it does not pretend to express the natural affinities of the species and their sequence, therefore differs from that of the enumeration where the species are grouped as much as possible according to their relationship. The descriptions of the leaves refer to those of sterile branches; the leaves of fertile branches are as a rule shorter and thicker, usually more or less upturned and ascending, acute and often spiny-pointed and have in some cases internal

resin-ducts, even if the leaves of the sterile branches have the resin-ducts marginal.

A. Leaves without stomata above (or sometimes with few incomplete lines of stomata near apex in Nos. 1, 18, and 25).
B. Branchlets deeply grooved, particularly on two-year-old branches.
C. Pubescence lacking on branchlets: leaves with internal resin-ducts ..... 14. *A. homolepis*
CC. Pubescence of branchlets brown, in the grooves: leaves with marginal resin-ducts ..... 15. *A. spectabilis*
BB. Branchlets not or slightly grooved.
C. Under surface of leaves without conspicuous white or glaucous bands (sometimes fairly conspicuous in *A. chensiensis*).
D. Apex of leaves acutish to spiny-pointed.
E. Cones violet-purple: leaves of upper ranks partly recurved; resin-ducts marginal: winter-buds very resinous ..... 11. *A. recurvata*
EE. Cones green: leaves spreading at nearly right angles or upper ranks directed forward: resin-ducts internal: winter-buds thinly resinous ..... 12. *A. holophylla*
DD. Apex of leaves emarginate or bifid: resin-ducts marginal.
E. Cones green: leaves more or less pectinate: buds not or slightly resinous.
F. Leaves emarginate: branchlets glabrous ..... 10. *A. chensiensis*
FF. Leaves sharply bifid (at least in young plants): branchlets slightly grooved, hairy in the grooves ..... 13. *A. firma*
EE. Cones purple: leaves of upper ranks directed forward, slender, often curved, bifid at apex: buds resinous ..... 16. *A. Pindrow*
CC. Under surface of leaves with 2 white or glaucous stomatic bands.
D. All branchlets more or less pubescent.
E. Buds resinous.
F. Foliage more or less pectinate.
G. Winter-buds very resinous.
H. Leaves distinctly pectinate, 1¼–2½ inches long: branchlets soon glabrous and lustrous ..... 28. *A. grandis*
HH. Leaves not all strictly pectinate, ½–1¼ inches long.
I. Apex of leaves acute to obtusish; resin-ducts marginal ..... 17. *A. religiosa*
II. Apex of leaves truncate to emarginate; resin-ducts internal ..... 25. *A. balsamea*
GG. Winter-buds slightly resinous: leaves very white beneath, to 1½ inches long, sharply bifid: branchlets slightly grooved ..... 6. *A. Faxoniana*
FF. Foliage not pectinate.

GG. Direction of leaves spreading upward and outward.
H. Length of leaves ½–¾ inch; resin-ducts internal.
I. Leaf with 8–12 lines of stomata in each band: bracts of cone much exserted...24. *A. Fraseri*
II. Leaf with 4–8 lines of stomata in each band: bracts not or slightly exserted..25. *A. balsamea*
HH. Length of leaves about 1 inch; resin-ducts marginal (internal in No. 7).
I. Branchlets soon glabrous, yellowish: buds thinly resinous..... 4. *A. koreana*
II. Branchlets densely pubescent, brown: buds very resinous.
J. Apex of leaves truncate or emarginate: bark smooth..... 3. *A. Veitchii*
JJ. Apex of leaves acutish to obtuse: bark flaky..... 7. *A. squamata*
GG. Direction of leaves forward.
H. Width of leaves $\frac{1}{12}$ inch or more.
I. Pubescence of branchlets pale, short: leaves about 1 inch long; resin-ducts marginal.....27. *A. amabilis*
II. Pubescence of branchlets dense, rufous: leaves ½–¾ inch long; resin-ducts internal..... 5. *A. Mariesii*
HH. Width of leaves $\frac{1}{24}$–$\frac{1}{16}$ inch, to 1½ inches long; resin-ducts internal.
I. Branchlets smooth, minutely pubescent: leaves with 4–5 lines of stomata in each band..... 1. *A. sibirica*
II. Branchlets slightly grooved, withh airs in the grooves: leaves with 7–8 lines of stomata in each band..... 2. *A. sachalinensis*
EE. Buds not resinous: leaves with marginal resin-ducts: cones green.
F. Foliage not pectinate.
G. Cone with hidden bracts: leaves spreading upward and outward .....21. *A. cilicica*
GG. Cone with exserted and reflexed bracts: leaves directed forward.....22. *A. Nordmanniana*
FF. Foliage pectinate: cone with exserted bracts....23. *A. alba*
DD. All branchlets glabrous (often slightly hairy in Nos. 8 and 9): resin-ducts marginal.
E. Apex of leaves obtuse or emarginate, rarely acutish: branchlets brown: cones purple or violet.
F. Winter-buds resinous: leaves slender, ⅗–1 inch long, emarginate.
G. Leaves not or scarcely revolute; resin-ducts internal on fertile branches..... 8. *A. Fargesii*
GG. Leaves revolute at the margin; resin-ducts marginal..... 9. *A. Delavayi*

FF. Winter-buds not resinous: leaves stout, ¼–¾ inch, usually obtuse, often with a few stomatic lines above ..... 18. *A. numidica*

EE. Apex of leaves sharply pointed.

F. Leaf ½–1 inch long, radially spreading: buds resinous, small: bracts of cones exserted and reflexed ..... 20. *A. cephalonica*

FF. Leaf pectinate, to 2 inches long: winter-buds large, pointed, not resinous: cone bristly with the long upright tips of the bracts ..... 32. *A. venusta*

AA. Leaves stomatiferous on both sides, grayish-green or glaucous: buds resinous.

B. Position of leaves radially spreading, pointed, short and rigid: resin-canal internal ..... 19. *A. Pinsapo*

BB. Position of leaves not radially spreading.

C. Buds completely covered with resin: leaves flat.

D. Branchlets pubescent: leaves not pectinate, with internal resin-ducts ..... 26. *A. lasiocarpa*

DD. Branchlets glabrous: leaves pectinate, with marginal resin-ducts ..... 29. *A. concolor*

CC. Buds thinly resinous, with a ring of free acuminate scales at base: leaves of the upper ranks curving upward from an appressed base; resin-canals marginal.

D. Bracts of cone much exserted and reflexed: leaves of sterile branches flat and grooved above ..... 30. *A. nobilis*

DD. Bracts of cone hidden or slightly exserted: leaves 4-sided ..... 31. *A. magnifica*

1. A. sibirica, Ledeb. (*A. pichta,* Forb. *A. Semenovii,* Fedtsch.). SIBERIAN F. Tree to 100 feet tall; bark smooth; winter-buds globose, resinous; branchlets gray, minutely pubescent: leaves linear, slender, up to 1¼ inches long, rounded and entire or bifid at apex, lustrous, bright green above, often with 2 or 3 short lines of stomata near apex, with 2 narrow grayish bands beneath, crowded and directed forward: cone cylindric, 2–3 inches long, bluish before maturity; scales about ⅜ inch wide, with denticulate margin; bracts hidden, scarcely half as long as scale. Northern Russia to Kamchatka, south to Turkestan and Manchuria.—Introduced to Europe about 1820. Hardy as far north as Canada, but starts to grow early and is often injured by late frosts. It is not very satisfactory in the Eastern States and is likely to become thin and scraggy.

A closely related species is **A. nephrolepis,** Maxim. (*A. sibirica,* Trautv. *A. gracilis,* Komar.). Bark of trunk rough; branchlets more pubescent: leaves shorter: cones smaller; bracts longer. Eastern Siberia, northern China.—Introduced in 1908 to Europe.

2. A. sachalinensis, Mast. (*A. Veitchii* var. *sachalinensis,* F. Schmidt). SAGHALIN F. Tree to 120 feet tall, with smooth light gray bark; winter-buds small, very resinous; branchlets slightly grooved, pubescent in the grooves: leaves similar to those of *A. sibirica,* but without stomata above and with

broader stomatic bands beneath and slightly broader and longer: cones about 3 inches long, gradually narrowed toward the apex; scales with entire margin, densely pubescent outside; bracts exserted and reflexed. Northern Japan, Saghalin, and Kurile Islands.—Introduced in 1878 by W. A. Clark to the Arnold Arboretum and in 1879 to Great Britain by Maries. Hardy north to Canada, but not particularly ornamental on account of its thin habit.

Var. **nemorensis,** Mayr. Cones smaller with hidden bracts. Saghalin.—Introduced in 1914 by E. H. Wilson to the Arnold Arboretum.

65. Abies Veitchii.

3. **A. Veitchii,** Lindl. VEITCH F. Fig. 65. Tree to 80 feet tall, with smooth grayish bark; winter-buds purplish, very resinous, the lateral almost united with the terminal one; branchlets brown, rather densely pubescent: leaves crowded, directed forward and more or less upward, on the lower side of the branchlets pectinate, linear, ½–1 inch long, truncate and notched at apex, lustrous dark green above, with 2 broad silvery-white bands beneath: cone cylindric, 1¾–2½ inches long, bluish-purple before maturity; bracts slightly exserted and reflexed; seeds with a broad short wing, scarcely as long as body. Central Japan.—Introduced in 1865 to Europe by Tschonoski and in 1876 to this country by Thomas Hogg. Hardy as far north as Ontario and New England and doing well; it is a desirable species of broad-pyramidal habit and particularly handsome while young.

Var. **olivacea,** Shiras. Cones green before maturity.—Introduced in 1914 to the Arnold Arboretum by E. H. Wilson.

4. **A. koreana,** Wils. KOREAN F. Tree to 50 feet; bark of older trees rough, fissured into irregular plates; branchlets sparingly pubescent, yellowish at first, becoming glabrous and purplish; winter-buds thinly resinous: leaves crowded, usually broader toward the apex, rounded and emarginate, or on young plants pointed, ⅓–¾ inch long, revolute at the margin, lustrous above, with whitish bands beneath: cone cylindric, 2–3 inches long and about 1 inch in diameter, violet-purple before maturity; scales about ¾ inch broad; bracts about as long as scales, slightly exserted and reflected. Korea.—Introduced to France about 1908 and in 1918 by E. H. Wilson to the Arnold Arboretum, where it has so far proved hardy.

5. **A. Mariesii,** Mast. MARIES F. Tree to 80 feet tall, with smooth pale gray bark, rough at base of old trees; winter-buds subglobose, small,

resinous; branchlets densely rusty-pubescent: leaves crowded, those of the middle ranks directed forward and nearly appressed, the lateral ones longer and spreading, linear, slightly broader above the middle, rounded or bifid at apex, ⅓–¾ inch long, lustrous above, with white bands beneath: cone ovoid to oblong-ovoid, narrowed toward the ends, 1¾–3½ inches long, dark purple before maturity; scales about 1 inch broad; bracts hidden; seed-wings twice as long as body. Mountains of Japan.—Introduced in 1879 to Great Britain by Charles Maries. Hardy as far north as Massachusetts, but not doing as well as *A. Veitchii*.

6. **A. Faxoniana,** Rehd. & Wils. Faxon F. Tree to 120 feet tall; bark dark gray, furrowed; winter-buds ovoid, purple, very resinous; branchlets densely brown-pubescent, slightly grooved: leaves crowded, irregularly spreading in two ranks, the upper rows shorter, linear, obtuse to emarginate, rarely mucronate, slightly revolute at the margins, ½–1 inch long, lustrous dark green above, with white bands beneath; resin-ducts internal or marginal: cone ovoid-oblong, 2–3 inches long, violet-purple before maturity; scales about ¾ inch broad; bracts somewhat exserted, upright or reflexed; seed-wing scarcely as long as body. Western China.—Introduced in 1911 by E. H. Wilson to the Arnold Arboretum where it has proved fairly hardy, but so far not very promising.

7. **A. squamata,** Mast. Flaky F. Tree to 120 feet tall; bark purplish-brown, exfoliating in thin flakes; winter-buds subglobose, reddish-brown, very resinous; branchlets densely brownish pubescent: leaves crowded and ascending, linear, often falcate, obtuse or acutish, ⅜–1 inch long, bluish-green above, with white bands beneath: cone oblong-ovoid, 2–2½ inches long, violet before maturity, resinous; scales about ⅜ inch wide; bracts slightly exserted. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it is apparently not quite hardy. Remarkable for its flaky bark which begins to exfoliate on the primary branches when about six years old, the inner bark purplish-red even on young branches.

8. **A. Fargesii,** Franch. Farges F. Tree to 100 feet tall; winter-buds resinous; branchlets glabrous, reddish-brown or purplish, slightly grooved and often hairy in the grooves: leaves on upper side of branchlets crowded, spreading at nearly right angles, the middle ranks upright or nearly reflexed, those below pectinate, linear, sometimes falcate, emarginate or bifid at apex, about 1 inch long, dark green and lustrous above, with white bands beneath: cones ovoid-oblong, 2–3 inches long; scales about ¾ inch wide; bracts slightly exserted and recurved. Central China.—Introduced in 1901 by E. H. Wilson to Great Britain, in 1907 to the Arnold Arboretum. Hardy as far north as Massachusetts and promises to be one of the most satisfactory species of the Chinese firs.

A closely related species is **A. sutchuenensis,** Rehd. & Wils. (*A. Fargesii*

var. *sutchuenensis*, Franch.). Differs chiefly in its stouter and shorter ascending leaves acute or obtuse, with distinct yellow petioles. Western China.—Introduced by Wm. Purdom to the Arnold Arboretum in 1911.

9. **A. Delavayi,** Franch. (*A. Faberi,* Craib. *Keteleeria Fabri,* Mast.). DELAVAY F. Tree to 120 feet tall; bark gray, fissured in old trees; winter-buds resinous; branchlets usually glabrous, red-brown, lustrous, slightly grooved and often hairy in the grooves: leaves crowded, spreading at nearly right angles, those of the middle ranks much smaller, nearly upright, and often upturned, scarcely pectinate below, linear, emarginate at apex, $\frac{3}{5}$–1 inch long, acute at the margin and usually strongly revolute, dark green above with wide bands beneath: cones cylindric-oblong, $2\frac{1}{2}$–3 inches long, violet-black before maturity; scales about $\frac{3}{4}$ inch wide and entire at the margin; bracts slightly exserted. Western China.—Introduced by E. H. Wilson in 1901 to Great Britain, and in 1908 to the Arnold Arboretum.

A related species is **A. Beissneriana,** Rehd. & Wils. Tree to 180 feet tall; bark fissured, dark gray; branchlets yellowish or grayish-yellow, rarely slightly puberulous: leaves crowded, linear-ligulate, nearly plane above and sometimes stomatiferous near apex, with pale or glaucescent bands beneath: cone peduncled; bracts hidden. Western China.—Introduced by E. H. Wilson in 1904 to Great Britain and in 1908 to the Arnold Arboretum where it did not prove hardy.

Into this affinity seems to belong **A. Forrestii,** Craib. Tree to 60 feet tall; branchlets brown, glabrous or slightly hairy: leaves pectinately arranged, ascending and forming a V-shaped groove, those of lower and upper ranks directed forward and upward and curving slightly backward, exposing the white under side, linear, to $1\frac{1}{2}$ inches long, rounded or emarginate, with broad white bands beneath: mature cones not known. Southwestern China.—Introduced about 1910 by G. Forrest to Great Britain. Not yet in cultivation in this country.

10. **A. chensiensis,** Van Tiegh. SHENSI F. Tree to 120 feet tall; winter-buds ovoid, slightly resinous; branchlets glabrous, yellowish-gray, older ones dark gray: leaves horizontally spreading and more or less 2-ranked, linear, broader above the middle, $\frac{3}{5}$–$1\frac{1}{2}$ inches long, usually rounded and emarginate at apex, rarely acutish, shining dark green above, with grayish-green or sometimes glaucescent bands beneath: cones ovoid-oblong, 3–4 inches long and nearly 2 inches in diameter, green while young, finally cinnamon-brown; scales about $1\frac{1}{4}$ inches wide, erose at the margin and tomentose outside; bracts hidden. Central China.—Introduced in 1907 by E. H. Wilson to the Arnold Arboretum where it has proved hardy, but grows slowly. A very distinct species.

11. **A. recurvata,** Mast. Tree to 120 feet tall, with rough dark gray or reddish-brown bark; buds ovoid, very resinous; branchlets glabrous and

lustrous, yellowish-gray: leaves spreading at nearly right angles on the middle ranks and partly more or less recurved, pectinate below, linear, ⅗–1½ inches long, shorter on fertile branches, acutish or sharply pointed, lustrous or bluish-green above, paler green beneath: cones oblong-ovoid, 2–4 inches long, violet-purple before maturity, finally grayish-brown; scales about ⅗ inch wide; bracts hidden. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved hardy. A handsome fir, very distinct on account of the partly recurved spiny leaves.

12. **A. holophylla,** Maxim. Needle F. Tree to 100 feet tall; winter-buds slightly resinous; branchlets yellowish-gray, glabrous, slightly grooved: leaves spreading at nearly right angles outward and upward, pectinate below, linear, entire at apex and spiny-pointed in young plants, acute or obtusish in older trees, lustrous bright green above, with grayish or slightly whitish bands beneath: cone cylindric, 5–6 inches long, green when young, finally dull light brown; scales 1½–2 inches wide; bracts hidden. Manchuria and Korea.—Introduced in 1905 to the Arnold Arboretum where it has proved hardy and promises to become a handsome and distinct tree of pyramidal habit with bright green lustrous foliage.

13. **A. firma,** Sieb. & Zucc. (*A. bifida,* Sieb. & Zucc. *A. Momi,* Sieb.). Momi F. Tree to 120 feet tall; bark dark gray, soon becoming scaly, fissured on old trees; buds small, slightly resinous; branchlets brownish, slightly grooved, short-pubescent in the grooves: leaves pectinate, linear, broadest about the middle, with bifid pungent apex on young plants, obtuse and emarginate on older plants, up to 1½ inches long, lustrous dark green above, not keeled and with grayish bands beneath: cone cylindric, gradually narrowed toward the apex, 4–5 inches long, yellowish-green before maturity; bracts exserted, not reflexed. Japan.—Introduced to Great Britain in 1861 by J. G. Veitch and the following year by Dr. G. R. Hall to this country. It is hardy as far north as New York and can be grown in sheltered positions in eastern Massachusetts. It is not doing as well as the other Japanese firs in the Eastern States, and is likely to become a thin, rather scraggy tree when older.

14. **A. homolepis,** Sieb. & Zucc. (*A. brachyphylla,* Maxim.). Nikko F. Fig. 66 and Plate XXV. Tree to 120 feet tall; bark scaly; winter-buds ovoid, resinous; branchlets deeply grooved, particularly on two- and three-year-old branchlets, grayish, glabrous: leaves spreading outward and upward, separated in the middle by a V-shaped depression, pectinate below, those of the outer ranks about 1 inch long, of the middle ranks shorter, linear, rounded and slightly bifid at apex, shining dark green above, with broad white bands beneath: cones cylindric, slightly narrowed at the ends, about 4 inches long, purple before maturity; scales about ⅘ inch wide, entire at the margin; bracts hidden. Japan.—Introduced in 1861 to Great Britain by J. G. Veitch.

Hardy as far north as New England and southern Ontario, and it has proved, in the Eastern States, one of the most satisfactory and ornamental firs; it forms a broad pyramidal tree usually densely branched to the ground and with dark green lustrous foliage.

66. Abies homolepis.

Var. **umbellata,** Wils. (*A. umbellata,* Mayr. *A. umbilicata,* Mayr). Cone green before maturity.—Introduced in 1891 by Dr. H. Mayr to Europe and to this country.

Var. **Tomomi,** Rehd. (*A. Tomomi,* Bobbink & Atkins). More sparingly branched and with shorter leaves.

A related species is **A. Kawakamii,** Hayata. Branchlets deeply grooved, yellowish, pubescent in the grooves or nearly glabrous: leaves pointing forward, the upper ranks ascending and curved: cones 2–3 inches long. Formosa.—Not yet introduced.

15. **A. spectabilis,** Spach (*A. Webbiana,* Lindl.). Himalayan F. Tree to 150 feet tall; bark scaly, rough; winter-buds large, subglobose, resinous; branchlets reddish-brown, deeply grooved, pubescent in the grooves: leaves arranged as in *A. homolepis,* but larger, 1–2⅓ inches long, rounded or bifid at apex, lustrous dark green above, with broad white bands beneath: cones cylindric, 6–7 inches long, violet-purple before maturity; scales about ¾ inch broad; bracts hidden or slightly exserted. Sikkim and Bhutan Himalaya. —Introduced in 1822 to Great Britain. A handsome tree with wide-spreading

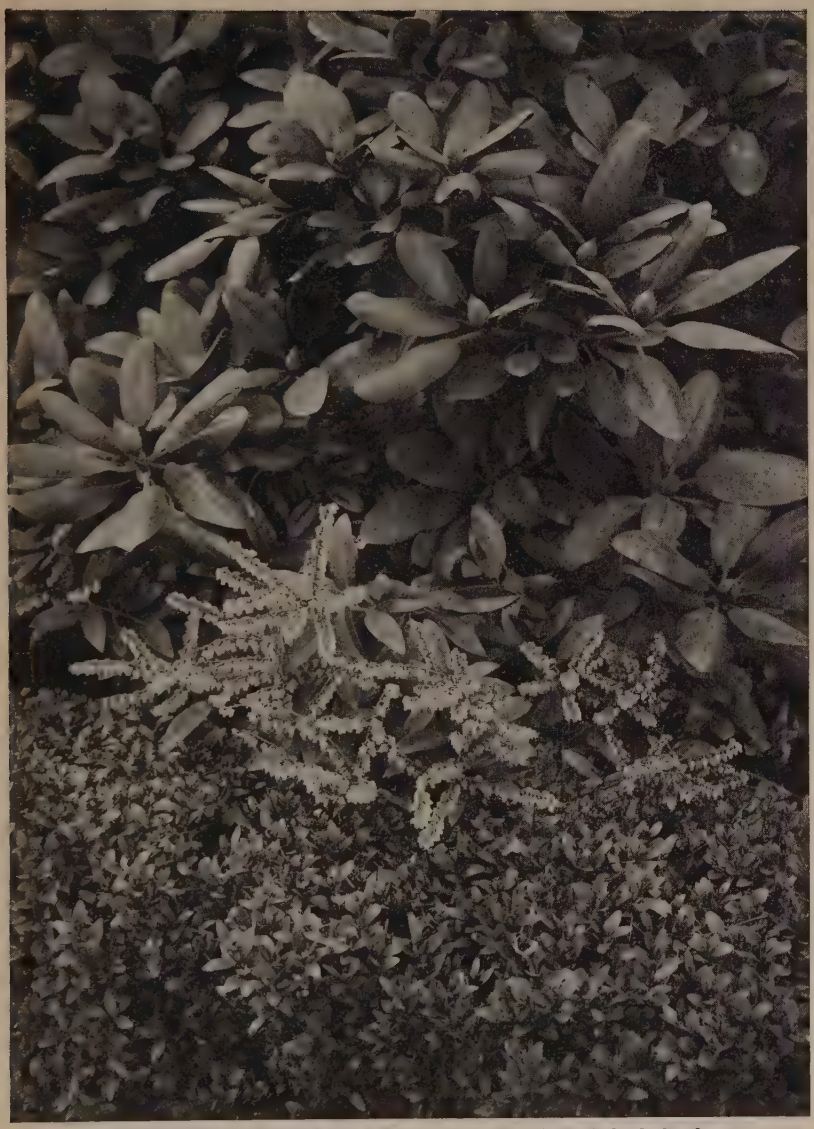


PLATE XLVII. Broad-leaved evergreens.—Pieris and rhododendron

PLATE XLVIII. The mountain laurel (*Kalmia latifolia*)

branches forming a broad-pyramidal head; possibly hardy as far north as the Middle Atlantic States.

Var. **brevifolia,** Rehd. (*A. Webbiana* var. *brevifolia,* Henry). Leaves shorter, not exceeding 1¼ inches, with grayish-white bands beneath. Northwestern Himalaya.—Somewhat hardier than the type.

16. **A. Pindrow,** Spach (*A. Webbiana* var. *Pindrow,* Brandis). PINDROW F. Tree to 200 feet tall; bark smooth and gray on young trees, grayish-brown and fissured on old trees; winter-buds large, resinous; branchlets smooth and glabrous, gray: leaves crowded above, the middle ranks directed forward, pectinate below, narrowly linear, narrowed into a bifid acute apex, entire in young plants, 1–2⅓ inches long, lustrous dark green above and with pale grayish bands beneath: cone cylindric, 4–5½ inches long, deep purple while young; scales 1¼ inches wide; bracts hidden. Himalaya: Kumaon to Kashmir.—Probably hardy as far north as the Middle Atlantic States.

17. **A. religiosa,** Schlecht. (*A. hirtella,* Lindl.). Tree to 150 feet tall; bark gray or grayish-brown, fissured into oblong plates; winter-buds globose-ovoid, resinous; branchlets brown, short-pilose: leaves pectinate, the middle ranks directed forward, linear, narrow, acute to obtusish, ⅔–1¼ inches long, dark green above, with white or grayish-white bands beneath: cones cylindric-oblong, 5–6 inches long and 2–2½ inches in diameter, dark violet-blue before ripening; bracts longer than the scale, reflexed. Mexico.—Introduced in 1838 to Europe. Probably hardy only in California and the Southern States.

18. **A. numidica,** De Lannoy (*A. baborensis,* Let. *A. Pinsapo* var. *baborensis,* Coss.). ALGERIAN F. Plate XXVI. Tree to 60 feet tall; bark gray, smooth; winter-buds ovoid, large, not or slightly resinous; branchlets glabrous and lustrous: leaves much crowded above, spreading outward and upward, on stronger branchlets more or less backward, on weaker ones with a V-shaped depression in the middle, pectinate below, stout, linear, often broadest above the middle, rounded at apex and slightly emarginate or entire, rarely acutish, ⅜–¾ inch long and $\frac{1}{12}$ inch broad, dark green above, often only faintly grooved and usually stomatiferous near apex or on fruiting branches with several stomatic lines, with white bands beneath: cones cylindric, 5–7 inches long; scales 3¼ inches broad, with entire margin; bracts hidden. Northern Africa.—Introduced into France in 1862. This species is doing well in the Eastern States and is hardy as far north as New York and in sheltered positions to Massachusetts. A handsome and distinct species of broad-pyramidal habit with stiff branches densely covered with short stout leaves.

A related but yet incompletely known species is **A. nebrodensis,** Mattei, from Sicily, with resinous winter-buds and pubescent branchlets; it is in cultivation in France. Another related species is **A. maroccana,** Trabut, from Morocco, also incompletely known and not in cultivation.

19. **A. Pinsapo,** Boiss. SPANISH F. Plate XVII. To 80 feet; bark smooth,

fissured in old trees; winter-buds ovoid, resinous; branchlets glabrous, brownish: leaves spreading radially at nearly right angles, linear, thick and rigid, acute or obtusish, $\frac{3}{5}$–$\frac{3}{4}$ inch long, dark green and stomatiferous and slightly convex above, with grayish bands beneath: cones cylindric, 4–5 inches long, purplish-brown; scales about 1 inch wide, with entire margin; bracts small, hidden. Spain.—Introduced in 1837 by Captain Widdrington to Great Britain. Hardy in sheltered positions as far north as Massachusetts. A handsome tree of striking appearance doing well on limestone soil.

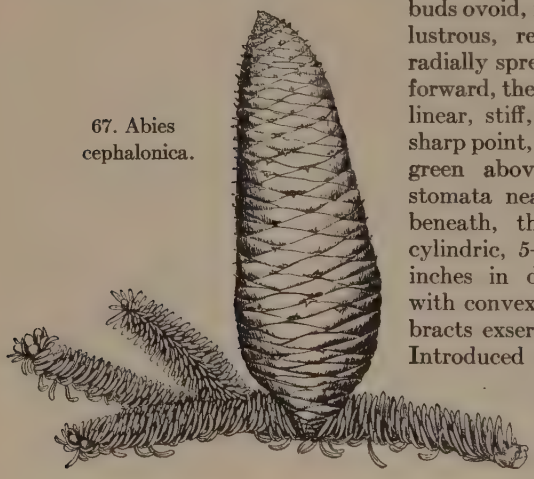
Var. **argentea,** Beiss. With silvery-white foliage. Var. **glauca,** Beiss. Blue Spanish F. With glaucous foliage.

Of this species the following hybrids are known:

A. Vilmorinii, Mast. (*A. cephalonica* × *A. Pinsapo*). A handsome vigorous tree with spreading spiny-pointed leaves about 1 inch long; intermediate between the parents. Originated in 1868 in France.

A. insignis, Carr. (*A. Nordmanniana* × *A. Pinsapo*). A broad-pyramidal vigorous tree; winter-buds resinous: leaves crowded, the upper ranks pointing forward, thickish, lustrous bright green, usually obtuse at apex, about 1 inch long. Raised first in 1872 and repeatedly afterward; several forms have been distinguished, as var. **Beissneriana,** Rehd. (*A. Beissneriana,* Mott.), var. **Kentiana,** Rehd. (*A. Kentiana,* Mott.), var. **Mastersiana,** Rehd. (*A. Mastersiana,* Mott.), and var. **speciosa,** Rehd. (*A. Nordmanniana speciosa,* Bailly).

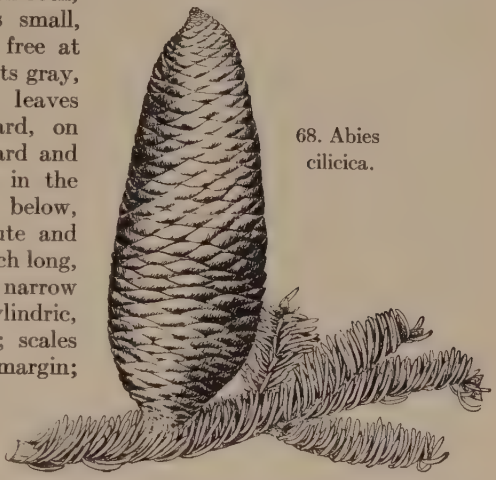
20. **A. cephalonica,** Loud. (*A. panachaica,* Heldr. *A. Reginæ-Amaliæ,* Heldr.). Greek F. Fig. 67. Plate VII. To 100 feet; bark grayish-brown, smooth, fissured in old trees; winter-buds ovoid, reddish, resinous; branchlets lustrous, red-brown, glabrous: leaves radially spreading and slightly directed forward, the middle ranks above shorter, linear, stiff, gradually narrowed into a sharp point, $\frac{1}{2}$–1 inch long, shining deep green above, sometimes with a few stomata near apex, with white bands beneath, the margins obtuse: cones cylindric, 5–7 inches long and $1\frac{3}{4}$–2 inches in diameter, brownish; scales with convex undulate or entire margin; bracts exserted and reflexed. Greece.—Introduced in 1824 to Great Britain. Hardy as far north as Massachusetts; a handsome tree with radially spreading pungent leaves.



67. Abies cephalonica.

Var. **Apollinis,** Beiss. (*A. Apollinis,* Link). Branchlets yellowish: leaves more crowded above, only a few leaves below spreading downward and forward, thicker and broader, acute or sometimes obtusish.—Introduced in 1850 to Germany.

21. **A. cilicica,** Carr. Cilician F. Fig. 68 and Plate XXVII. Tree to 100 feet tall; bark ashy-gray, smooth, scaly in old trees; winter-buds small, with few keeled acute scales, free at the tips, not resinous; branchlets gray, with scattered short hairs: leaves spreading upward and forward, on weak shoots outward and upward and leaving a V-shaped depression in the middle, somewhat pectinate below, linear, slender, rounded or acute and slightly bifid at apex, about 1 inch long, shining bright green above, with narrow white bands beneath: cones cylindric, 7–9 inches long, reddish-brown; scales 1¾–2 inches broad, with entire margin; bracts hidden. Asia Minor, Syria.—Introduced in 1853 to Europe by Kotschy. Hardy as far north as southern Ontario and New England. A handsome fir similar to *A. Nordmanniana,* but with slenderer branches.



68. Abies cilicica.

22. **A. Nordmanniana,** Spach. Nordmann F. Plate VII. To 150 feet; bark grayish-brown, slightly fissured in old trees; winter-buds ovoid, acute, with slightly keeled obtusish scales, not resinous; branchlets gray with scattered short hairs: leaves directed forward and densely covering the branchlets, pectinate below, linear, rounded and bifid at apex, ¾–1½ inches long, lustrous dark green above, with whitish bands beneath: cones cylindric, 5–6 inches long, reddish-brown; scales about 1½ inches wide; bracts exserted and reflexed. Caucasus, Asia Minor, Greece.—Hardy as far north as southern Ontario and New England. Introduced about 1840 to Europe. A handsome and desirable species forming a narrow-pyramidal densely branched tree with dark green foliage.

Var. **aurea,** Beiss. With yellow foliage.

Var. **tortifolia,** Rehd. Leaves of the middle ranks above falcate and twisted, partly exposing the white under side.

23. **A. alba,** Mill. (*A. pectinata,* DC. *A. Picea,* Lindl., not Mill.). Silver F. Plate XXXV. To 150 feet; bark grayish, scaly in old trees; winter-

buds small, with few obtuse scales, not resinous; branchlets gray, with scattered short hairs: leaves pectinate, those of the upper and middle ranks pointing outward and upward, linear, rounded and bifid at apex, $\frac{3}{5}$–$1\frac{1}{4}$ inches long, lustrous dark green above, with white bands beneath: cones cylindric, 4–$5\frac{1}{2}$ inches long, green while young, finally reddish-brown; scales about 1 inch broad, tomentose outside; bracts exserted and reflexed. Mountains of Central and southern Europe.—Hardy as far north as southern Ontario and New England, but not very satisfactory in the Eastern States.

Var. **pendula,** Asch. & Graebn. (*A. pectinata pendula*, Carr.). Weeping Silver F. With pendulous branches.

Var. **pyramidalis,** Voss (*A. alba fastigiata*, Asch. & Graebn. *A. pectinata pyramidalis*, Carr.). Sentinel Silver F. With ascending branches forming a columnar head.

Var. **columnaris,** Rehd. (*A. pectinata columnaris*, Carr.). Columnar Silver F. With very short branches of nearly equal length forming a columnar head.

Var. **equi-trojani,** Asch. & Sint. Leaves attenuate toward the apex and slightly emarginate: cones oblong-cylindric; bracts much exserted. Asia Minor.—This variety forms a transition to *A. cephalonica*; it is probably not in cultivation.

24. **A. Fraseri,** Poir. Fraser F. (Southern Balsam F.). Tree to 70 feet tall; bark smooth, reddish and scaly in old trees; winter-buds small, subglobose, very resinous; branchlets yellowish-gray, densely covered with short reddish hairs: leaves crowded, spreading upward and forward, pectinate below, linear, rounded and bifid at apex, $\frac{3}{5}$–1 inch long, shining dark green above, with broad white bands beneath: cones oblong-ovoid or ovoid, $1\frac{1}{2}$–$2\frac{1}{4}$ inches long, purple before maturity; scales about $\frac{3}{4}$ inch wide; bracts exserted and reflexed. Alleghany Mountains from West Virginia to North Carolina and Tennessee.—Introduced to Europe in 1811 by John Fraser. Hardy as far north as southern Ontario and New England, but not very satisfactory under cultivation.

25. **A. balsamea,** Mill. Balsam F. Tree to 70 feet tall; bark grayish-brown, scaly on old trees; winter-buds small, reddish, very resinous; branchlets ashy-gray, short-pubescent: leaves spreading upward, pectinate below, on weaker branchlets indistinctly pectinate above, linear, rounded and slightly bifid at apex, $\frac{3}{5}$–1 inch long, lustrous dark green above and often with a few stomatic lines near apex, with narrow grayish-white bands beneath: cones oblong, $1\frac{1}{2}$–$2\frac{1}{2}$ inches long, violet-purple before maturity; scales $\frac{3}{5}$ inch wide; bracts usually inclosed (exserted in var. **phanerolepis,** Fern.). Labrador to West Virginia, west to Minnesota and Iowa.—Introduced to England in 1698 by Bishop Compton. Hardy as far north as Canada, but not growing satisfactorily outside of its natural habitat.

Var. **hudsonia**, Engelm. (*Picea Fraseri hudsonia*, Knight). Hudson F. Dwarf form with dark green shorter and broader leaves.

Var. **macrocarpa**, Kent. Leaves longer and cones 3–3½ inches long. Wisconsin.—Introduced before 1884 by R. Douglas. This variety forms a transition to the following species.

26. **A. lasiocarpa**, Nutt. (*A. subalpina*, Engelm.). Alpine F. Plate XXXV. Tree to 100 or even to 150 feet tall; bark smooth and silvery-gray, fissured in old trees; winter-buds small, ovoid, resinous; branchlets ashy-gray, with a short rufous pubescence: leaves much crowded, directed upward and forward, linear, rounded or acutish at apex, rarely emarginate, 1–1½ inches long, pale bluish-green, stomatiferous above and only slightly grooved, with broad pale bands beneath: cones oblong-cylindric, 2½–4 inches long, truncate or depressed at apex; scales ¾–1 inch wide; bracts hidden. Alaska to Oregon, Utah and northern New Mexico.—Introduced to Great Britain in 1863, to the Eastern States in 1873. Hardy as far north as Canada.

Var. **compacta**, Rehd. (*A. subalpina compacta*, Beiss.). A dwarf compact form.—Originated about 1873.

Var. **arizonica**, Lemm. (*A. arizonica*, Merriam). Cork F. Bark thick and corky, grayish-white: leaves emarginate at apex, with bluish-white bands beneath, the lower ranks pectinate, the upper ones directed forward. Northern Arizona and northern New Mexico.—Introduced to Europe in 1901.

27. **A. amabilis**, Forbes. Cascade F. Tree to 250 feet tall; bark silvery-white or pale, at the base of old trees thick and furrowed; winter-buds globose, very resinous; branchlets gray, densely pubescent: leaves crowded, the upper ranks directed forward, the lower ones spreading, pectinate below, linear, often broadest above the middle, truncate or bifid at the apex, about 1 inch long, shining dark green above, with broad white bands beneath: cones oblong, 3½–6 inches long, purple before maturity, puberulous; scales 1–1¼ inches wide; bracts hidden. British Columbia and Alberta to Oregon.—Introduced in 1830 to Great Britain. Hardy as far north as Massachusetts in sheltered positions. A very handsome fir of narrow-pyramidal habit.

28. **A. grandis**, Lindl. (*A. Gordoniana*, Carr. *A. amabilis*, Murr., not Forbes). Great F. Tree to 300 feet tall; bark smooth, brownish, fissured into thin plates and red-brown or grayish-brown at the base of old trees; winter-buds ovoid, resinous; branchlets olive-green, minutely pubescent: leaves pectinate, linear, rounded and bifid at apex, flexible, 1¼–2¼ inches long, shining dark green above, with white bands beneath: cones cylindric, 2–4 inches long, green; scales 3 or 4 times as long as the hidden bracts. Vancouver Island to northern California, east to Montana.—Introduced in 1831 to Great Britain. Hardy as far north as New York, but not very satisfactory in the Eastern States.

29. **A. concolor**, Lindl. & Gord. White F. Plate XXVIII. Tree to 120

feet tall; bark smooth gray, on old trees fissured and scaly; winter-buds globose, resinous; branchlets yellowish-green, minutely pubescent or nearly glabrous: leaves irregularly arranged, mostly spreading outward and curving upward, some of the middle ranks above directed forward, linear, acute, or rounded at apex, 1½–2 inches long, bluish-green, slightly convex and stomatiferous above, not grooved, convex and with pale bands beneath: cones cylindric, 3–5 inches long, narrowed at the ends, greenish or purplish before maturity; scales about 1 inch wide; bracts hidden. Colorado to southern California, northern Mexico and New Mexico.—Introduced in 1872 to the Eastern States and to Europe. Hardy as far north as southern Ontario and New England. This is the most satisfactory of American firs for cultivation in the Eastern States and withstands heat and drought better than any other fir.

Var. **violacea,** Beiss. PURPLECONE WHITE F. With bluish-white foliage.

Var. **argentea,** Niemetz. With silvery-white foliage.

Var. **Wattezii,** Beiss. Foliage first pale yellowish, changing to silvery-white.

Var. **globosa,** Beiss. Of globose habit, with short branches.

Var. **Lowiana,** Lemm. (*A. Lowiana,* Murr. *A. Parsonsiana,* Barron. *A. concolor* var. *lasiocarpa,* Engelm. & Sarg. *A. lasiocarpa,* Mast., not Nutt.). PACIFIC WHITE F. Plate VII. To 250 feet, winter-buds smaller: leaves pectinately arranged, 2–3 inches long, rounded and bifid at apex, shallowly grooved above. Oregon to California.—Introduced in 1851 to Great Britain. Much tenderer than the type.

30. **A. nobilis,** Lindl. NOBLE F. Tree to 250 feet tall; bark reddish-brown, deeply fissured, smooth in young trees; winter-buds resinous, the outer scales narrow and acuminate; branchlets minutely rusty-pubescent: leaves crowded above, the lower ranks spreading outward, the middle ranks much shorter, appressed to the branchlets near the base, then curving upward, linear, rounded and entire or slightly emarginate at apex, 1–1½ inches long, bluish-green, stomatiferous and grooved above, with narrow pale bands beneath: cones cylindric-oblong, slightly narrowed toward the apex, 6–10 inches long, green before maturity, becoming purplish-brown; scales 1¼–1½ inches wide; bracts much exserted and reflexed. Washington to northern California.—Introduced in 1830 to Great Britain. Hardy as far north as Massachusetts in sheltered positions.

Var. **glauca,** Beiss. BLUE NOBLE F. With glaucous foliage.

31. **A. magnifica,** Murr. (*A. nobilis* var. *magnifica,* Kellogg). RED F. Tree to 200 feet tall; winter-buds and branchlets like those of the preceding species: leaves less crowded, quadrangular in section, rounded and entire at apex, keeled and stomatiferous above, with pale bands beneath: cones cylindric-oblong, 6–9 inches long, pubescent, purplish-violet before maturity;

scales 1¼–1½ inches wide; bracts hidden. Oregon to California.—Introduced in 1851 to Great Britain. A handsome fir of regular habit, doing well in the Eastern States, but less hardy than the preceding species.

Var. **glauca,** Beiss. Azure F. With deep glaucous foliage.

Var. **argentea,** Beiss. With bluish-white foliage.

Var. **shastensis,** Lemm. (*A. shastensis*, Lemm.). Bracts exserted and often reflexed, covering nearly half the scales. Oregon to California.

32. **A. venusta,** K. Koch (*A. bracteata*, Nutt.). Bristlecone F. Tree to 150 feet tall; the lower branches pendulous, the upper short, forming a head abruptly narrowed from a broad pyramidal base into a slender spire; bark smooth, brown, fissured at the base of old trees; winter-buds elongated, acute, ⅜–1 inch long, not resinous; branchlets greenish, glabrous: leaves pectinate, linear-lanceolate to linear, rigid, spiny-pointed, 1¼–2½ inches long, shining dark green above, not grooved, with broad white bands beneath: cones ovoid, 3–4 inches long, purplish-brown, resinous; bracts exserted, upright, ending in rigid spines 1–2 inches long, giving the cone a bristly appearance. California.—Introduced to Europe in 1853. Outside of California possibly hardy in the Southern States. A very handsome fir of striking appearance.

22. PSEUDOTSUGA, Carr.

Tall evergreen trees with irregularly whorled branches; winter-buds ovoid, acute, not resinous; branchlets nearly smooth, marked with oval scars after the leaves have fallen: leaves more or less 2-ranked, linear, flattened, green and grooved above, with a stomatiferous white band on each side of the prominent midrib beneath, with only 1 vascular bundle in the center, and with 2 subepidermal resin-canals: staminate flowers axillary, cylindric; female flowers terminal on short branchlets: cones pendent, ovate-oblong, maturing the same season; scales rounded, rigid, persistent; bracts longer than the scales, 2-lobed at the apex with the midrib produced into a rigid awn; each scale with 2 nearly triangular seeds with a wing shorter than the scale; cotyledons 6–12. (Name derived from Greek *pseudos*, and *tsuga*; meaning that the genus, though closely related to Tsuga, is not a true Tsuga.) —Four species: two in western North America, one in Japan, and one in China and Formosa.

P. taxifolia, Britt. (*P. Douglasii*, Carr. *P. mucronata*, Sudw. *P. Lindleyana*, Carr. *Abies Douglasii*, Lindl. *Abietia Douglasii*, Kent). Douglas Fir (Douglas Spruce, Red Fir). Fig. 29 and Plates XXIX, XXX. Pyramidal tree attaining 200 feet in height and sometimes more, with a trunk becoming 12 feet in diameter, clothed with ridged dark red-brown bark; branches horizontal, with pendulous branchlets: leaves linear, straight or curved, obtuse, slender and flexible, dark green or bluish-green, ¾–1¼

inches long: staminate catkins orange, the fertile ones reddish: cones pendulous, oval-ovoid, 2–4½ inches long, with broad rounded scales and much exserted bracts; seed ¼ inch long, with broad wing, light reddish-brown. From British Columbia to California, Montana, Colorado, western Texas, and northern Mexico.—Introduced in 1827 to Great Britain by David Douglas. In its Rocky Mountain form it is hardy as far north as southern Ontario and New England and is growing well in the Eastern States; it forms a pyramidal tree of dense yet graceful habit. A number of distinct forms are in cultivation.

Var. **viridis,** Asch. & Graebn. (*A. Douglasii viridis,* Schwerin). This is the typical green-leaved form from the coast region; it is of rapid growth and more open habit than the Rocky Mountain form, but tenderer.

Var. **cæsia,** Asch. & Graebn. (*P. Douglasii cæsia,* Schwerin), agrees with the type except that the leaves are bluish-green; it seems to be somewhat hardier.

Var. **brevibracteata,** Asch. & Graebn. (*P. Douglasii taxifolia,* Carr.). Smaller tree: leaves longer and darker: bracts of cone shorter.

Var. **glauca,** Sudw. (*P. Douglasii glauca,* Mayr. *P. glauca,* Mayr). Blue Douglas F. Of more compact habit; branches more ascending: leaves shorter, bluish-green: cones smaller, with often reflexed bracts. This is the Rocky Mountain form which is hardier than the type, but of slower, more compact growth. In northern Arizona and New Mexico a form of this variety with gray, thick and corky bark occurs (var. *suberosa,* Lemm.).

Var. **argentea,** Sudw. (*P. Douglasii argentea,* Koster). Silver Douglas F. Similar to the preceding, with almost silvery-white foliage.

Var. **Fretsii,** Rehd. (*P. Douglasii Fretsii,* Beiss.). Frets Douglas F. Leaves short and broad, about ½ inch long, obtuse at apex.

Var. **pendula,** Sudw. (*P. Douglasii pendula,* Engelm.). Weeping Douglas F. With pendulous branches and dark green foliage. Var. **"glauca pendula,"** Schneid. (*P. Douglasii glauca pendula,* Beiss.). With pendulous branches and bluish-green or bluish-white foliage.

Var. **fastigiata,** Sudw. (*P. Douglasii fastigiata,* Carr.). A narrow conical pyramid, with ascending branches and shorter leaves.

Var. **compacta,** Sudw. A compact conical form with short and dense foliage.

Var. **globosa,** Asch. & Graebn. (*P. Douglasii globosa,* Beiss.). A dwarf globose form.

The following three species are not or very little known in cultivation:

P. macrocarpa, Mayr (*P. Douglasii* var. *macrocarpa,* Engelm.). Bigcone Spruce. Closely related to *P. taxifolia:* a smaller tree with more remote and usually pendulous branches: leaves acutish, curved, bluish-green: cones 4–6½ inches long, with slightly exserted upright bracts. Southern California.—Apparently not yet introduced into cultivation.

P. japonica, Beiss. (*Tsuga japonica*, Shiras.). Tree to 100 feet tall; branchlets glabrous, pale yellowish-gray: leaves more or less directed forward, often slightly curved, emarginate, $\frac{3}{5}$–1 inch long, lustrous bright green above: cone ovoid, $1\frac{3}{4}$–2 inches long; bracts exserted and reflexed. Japan.—Introduced in 1898 to Europe and a year later to this country, but at the Arnold Arboretum the species did not prove hardy.

P. sinensis, Dode. Related to *P. japonica:* tall tree; branchlets brown, pubescent: leaves to $1\frac{1}{4}$ inches long, emarginate, more or less pectinately arranged: cones to $2\frac{1}{2}$ inches long, with puberulous scales and upright or reflexed bracts. Western China.—Introduced to France in 1912 and in 1914 to the Arnold Arboretum where it did not prove hardy. *Pseudotsuga Wilsoniana*, Hayata, from Formosa, and *P. Forrestii*, Craib, from Yunnan, are probably not different from *P. sinensis.*

23. TSUGA, Carr. HEMLOCK

Evergreen trees with slender horizontal branches and cinnamon-red furrowed bark; winter-buds minute, not resinous: leaves usually 2-ranked, short-petioled, linear, flat or angular, falling away in drying: staminate flowers axillary, subglobose; ovule-bearing flowers terminal, the scales about as long as the bracts, each with 2 ovules at the base: cones small, ovate, or oblong with thin flexible persistent scales, much longer than the bracts; seeds winged; cotyledons 3–6. (Tsuga is the Japanese name of the genus.)—Nine species in temperate North America, Japan, western China, and on the eastern Himalayas. The genus is closely allied to Abies and Picea and differs little in the structure of the flowers; the cones are very similar to those of the larch, but the leaves, which are much like those of Abies in their outward appearance, though smaller, are very different in their internal structure from all allied genera, having a solitary resin-duct situated in the middle of the leaf below the fibro-vascular bundle.

Tsuga should be called "hemlock spruce," but in common speech it is usually alluded to as "hemlock." The "hemlock" of the ancients is a poisonous umbelliferous herb (*Conium maculatum*).

A. Leaves with 2 white lines beneath, grooved above, much flattened, distinctly 2-ranked: cones $\frac{1}{2}$–$1\frac{1}{2}$ inches long. (Eutsuga, Engelm.).
  B. Margin of leaves entire; apex of leaves usually emarginate, sometimes obtuse.
    C. Branchlets glabrous, grayish- or yellowish-brown.....1. *T. Sieboldii*
    CC. Branchlets pubescent.
      D. Length of leaves $\frac{1}{3}$–$\frac{1}{2}$ inch, emarginate at apex: branchlets pubescent throughout, reddish-brown.....2. *T. diversifolia*
      DD, Length of leaves $\frac{1}{3}$–1 inch: branchlets yellowish-brown or gray, pubescent chiefly in the grooves,

EE. Cone-scales suborbicular: leaves emarginate, with inconspicuous bands beneath.....3. *T. chinensis*
EE. Cone-scales oblong-oval: leaves not or indistinctly emarginate, with conspicuous white bands.....4. *T. caroliniana*
BB. Margin of leaves finely denticulate, at least toward the apex; apex of leaves obtuse or acutish.
C. Under side of leaves with narrow well-defined bands about as broad as the green margin: cone peduncled, with glabrous almost orbicular scales.....5. *T. canadensis*
CC. Under side of leaves with broad not clearly defined bands much broader than the green margin: cone sessile, with oval slightly puberulous scales.....6. *T. heterophylla*
AA. Leaves stomatiferous on both sides, flat or convex above, spirally arranged: cones 2–3 inches long (HESPEROPEUCE, Engelm.)....7. *T. Mertensiana*

1. **T. Sieboldii,** Carr. (*T. Araragi*, Koehne). SIEBOLD H. Tree attaining 100 feet, with spreading slender branches; winter-buds ovoid, acutish, with glabrous ciliate scales; branchlets pale yellowish-brown, somewhat glossy, glabrous, with reddish leaf-cushions: leaves linear, usually broadest at the apex, emarginate, grooved and glossy dark green above, with narrow white bands beneath, ¼–¾ inch long: cone ovoid, 1–1¼ inches long, the peduncle exceeding the bud-scales; scales orbicular; bracts bifid. Japan.—Introduced in 1850 by Siebold to Europe. Hardy as far north as Massachusetts in sheltered positions.

2. **T. diversifolia,** Mast. (*Abies diversifolia*, Maxim. *T. Sieboldii nana*, Carr.). JAPANESE H. Tree, very similar to the preceding, but smaller and chiefly distinguished by the reddish-brown pubescent branches; winter-buds obovoid, flattened, minutely pubescent and ciliate: leaves linear, emarginate or obtuse, shorter and narrower, broadest at the middle or toward the base, ⅛–⅜ inch long: cone smaller, ½–¾ inch long; peduncle not exceeding the bud-scales; bracts truncate, crenulate, not or slightly bifid; cone-scales orbicular-ovate, lustrous, with slightly bevelled margin. Japan.—Introduced in 1861 by J. G. Veitch to Great Britain. Hardy as far north as Massachusetts. A graceful and handsome species growing well in the Eastern States.

3. **T. chinensis,** Pritz. CHINESE H. Tree to 150 feet tall; winter-buds ovoid, obtuse, glabrous; branchlets yellowish, later pale yellowish-gray, hairy only in the grooves: leaves linear, emarginate, ½–1 inch long, lustrous dark green above, beneath with broad whitish bands becoming inconspicuous: cones ovoid, ⅜–1 inch long; scales suborbicular, lustrous, yellowish-brown, with slightly bevelled margin. Western China.—Introduced by E. H. Wilson in 1901 to Great Britain and in 1908 to the Arnold Arboretum. Hardy in sheltered positions as far north as Massachusetts. A handsome species promising well in suitable localities.

The closely related **T. yunnanensis,** Mast., YUNNAN H., differs in the more densely pubescent branchlets, shorter and narrower, obtuse, not emarginate

leaves always very white beneath and in the dull cones with fewer scales slightly recurved at the apex. Western China.—Introduced to the Arnold Arboretum by E. H. Wilson in 1908. Tenderer than the preceding species.

4. **T. caroliniana,** Engelm. Carolina H. Fig. 69 and Plate XXXI. Tree attaining 70 feet in height, of more compact habit and with darker green foliage than the following; winter-buds obtuse, pubescent; young branchlets light reddish-brown, finely pubescent or almost glabrous: leaves linear, obtuse or slightly emarginate, dark green and glossy above, with white bands beneath, ⅓–¾ inch long: cones oblong, 1–1½ inches long, peduncled; scales oblong. Mountains of southwestern Virginia to northern Georgia.—Introduced into cultivation in 1881 through the Arnold Arboretum. Perfectly hardy in New England and a very desirable tree, handsomer than the common hemlock spruce.

69. Tsuga caroliniana.

5. **T. canadensis,** Carr. (*T. americana,* Farw. *Abies canadensis,* Michx.). Canada H. Fig. 70. Tree, attaining 70 and occasionally 100 feet in height;

70. Tsuga canadensis.

winter-buds obtuse, slightly puberulous; young branchlets yellowish-brown, pubescent: leaves linear, obtuse or acutish, dark green and obscurely grooved above, with 2 whitish bands beneath, ¼–⅔ inch long: cones ovoid, ½–¾ inch long, peduncled; scales orbicular-obovate, almost as wide as long. Nova Scotia to Maine and south along the mountains to Alabama.—Introduced to Great Britain in 1636 by Peter Collinson. Hardy as far north as Canada. The hemlock spruce yields the lumber most commonly used in the East for framing and clapboarding of buildings. It is not used for finishing lumber. It is a handsome ornamental tree and several garden forms have originated in cultivation.

Var. **albo-spica,** Beiss. WHITETIP H. Tips of the young branchlets creamy-white.

Var. **parvifolia,** Beiss. Leaves very small, ¼ inch long or shorter: branchlets stout, closely set and numerous.

Var. **gracilis,** Beiss. (var. *microphylla,* Hort.). SLENDER CANADA H. Slow-growing form with slender sparingly ramified branches, spreading and more or less drooping at the ends: leaves very small, about ¼ inch long.

Var. **compacta,** Sénécl. (var. *compacta nana,* Beiss.). DWARF CANADA H. Dwarf conical pyramid with numerous short branchlets clothed with small leaves.

Var. **nana,** Carr. Dwarf and depressed form with spreading branches and short branchlets.

Var. **pendula,** Beiss. (var. *Sargentii pendula,* Hort. var. *Sargentiana,* Kent). SARGENT WEEPING H. Flat-topped form with spreading branches and drooping branchlets.

6. **T. heterophylla,** Sarg. (*T. Albertiana,* Sénécl. *T. Mertensiana,* Carr.). WESTERN H. Tree attaining 200 feet in height, with short, slender, usually pendulous branches forming a rather narrow pyramidal head in older, but rather broad in young trees; winter-buds ovoid, obtuse; young branchlets pale yellowish-brown, pubescent for five or six years and with long pale hairs while young: leaves linear, obtuse or acutish, distinctly grooved and dark green above, with white bands below, ½–¾ inch long: cones oblong-ovoid, sessile, ¾–1 inch long; scales oval, slightly puberulous outside. Alaska to Idaho and California.—Introduced to Great Britain in 1851. A handsome tree of rapid growth in rich humid soil, but not doing well in the dry climate of the Eastern States and not hardy north of New York.

A related species is **T. dumosa,** Sarg. (*T. Brunoniana,* Carr.). Tree to 120 feet tall; branchlets light brown, pubescent: leaves tapering to an acute apex, with broad white bands beneath, leaving scarcely any green margin, ⅗–1¼ inches long: cone 1 inch long. Himalayas.—Introduced to Great Britain in 1838, but doing well only in favorable localities; scarcely known in this country.

7. **T. Mertensiana,** Sarg., not Carr. (*T. Pattoniana,* Sénécl. *T. Hookeriana,* Carr. *T. Roezlii,* Carr. *Abies Williamsonii,* Newb. *Hesperopeuce Pattoniana,* Lemm.). Mountain H. Tree attaining 100 and occasionally 150 feet, with slender pendent branches usually forming an open pyramid; winter-buds ovoid, acute; young branchlets light reddish-brown, pubescent, usually short and upright: leaves spirally arranged around the branches, linear, usually curved, acutish, mostly rounded or keeled, rarely slightly grooved above, light bluish-green or pale bluish-white, with whitish lines on both sides, ½–1 inch long: cones cylindric-oblong, usually violet-purple before maturity, brown when ripe, 2–3 inches long; scales obovate, puberulous outside. Southern Alaska to northern Montana, Idaho, and California. —Introduced to Great Britain in 1851 by Jeffrey. Hardy in sheltered positions as far north as Massachusetts, rarely cultivated in the Eastern States. To avoid confusion one has to bear in mind that *T. heterophylla* was known for a long time as *T. Mertensiana* and still bears this name in many gardens.

Var. **argentea,** Sudw. With bluish-white foliage.

A supposed hybrid of this and the preceding species is **T. Jeffreyi,** Henry (*T. Mertensiana* var. *Jeffreyi,* Schneid.). Buds ovoid, acute: leaves radially spreading and directed outward, green and grooved above with a few broken lines of stomata near apex, finely serrulate.—Originated from seed of *T. Mertensiana* introduced in 1851 by Jeffrey.

24. PICEA, A. Dietr. SPRUCE

Evergreen pyramidal trees with usually whorled branches and with scaly bark; branchlets with prominent leaf-cushions (pulvini) separated by incised grooves and produced at the apex into a peg-like stalk bearing the leaf: leaves usually 4-angled, with white lines formed by numerous stomata arranged in rows on all four sides, or compressed and stomatiferous only on the upper or ventral side which, on the lateral branchlets, by twisting of the leaf-stalk appears to be the lower one, sessile and jointed at the base to a short stalk-like projection (sterigma) of the pulvinus: flowers monœcious, catkin-like, terminal or axillary; the staminate yellow or red, consisting of numerous spirally arranged anthers with the connective enlarged at the apex and scale-like; the fertile ones greenish or purple, consisting of spirally arranged scales each subtended at the base by a small bract and bearing 2 ovules at the inner side: cones pendulous or spreading, with persistent scales not separating from the axis after shedding the seeds, which are provided with a large and thin obovate or oblong wing; cotyledons 4–15. (Picea is the ancient Latin name of the spruce, derived from *pix,* pitch.)—Thirty-eight species in the colder and temperate climates of the northern hemisphere from the arctic circle to the high mountains of the warm-temperate regions. They are

all mentioned below except *P. gemmata*, Rehd. & Wils., *P. hirtella*, Rehd. & Wils., and *P. Neoveitchii*, Mast., from China, which are not in cultivation.

A. Leaves quadrangular or slightly compressed, with stomatic lines on all four sides.
  B. Leaf nearly equally stomatiferous on all four sides, in cross-section as high as broad or higher than broad.
    C. Branchlets glabrous (sometimes pubescent in *P. Abies* and in a var. of *P. glauca*).
      D. Direction of leaves, at least those of the upper ranks, more or less pointing forward.
        E. Color of branchlets gray or yellowish to orange.
          F. Disposition of leaves radial, ¾–1¾ inches long: branchlets pendulous: cones 3–6 inches long.
            G. Winter-buds pointed: leaves 1–1¾ inches long, slender, gradually pointed ..... 1. *P. Smithiana*
            GG. Winter-buds obtuse: leaves ¾–1¼ inches long, rather abruptly pointed ..... 2. *P. Schrenkiana*
          FF. Disposition of leaves pectinate below: branchlets not pendulous: winter-buds acute or acutish.
            G. Branchlets pale gray or yellowish.
              H. Length of leaves ½–¾ inch: pulvini produced into a short petiole ..... 3. *P. Watsoniana*
              HH. Length of leaves ⅓–⅗ inch: pulvini scarcely produced into a petiole ..... 4. *P. Wilsoni*
            GG. Branchlets bright yellow to orange: pulvini produced into a stalk ¼ inch long ..... 5. *P. aurantiaca*
        EE. Color of branchlets brown or yellowish-brown.
          F. Cone 4–6 inches long: leaves bright or dark green, often spiny-pointed, usually ½–¾ inch long.
            G. Winter-buds not resinous, the terminal one with a few acuminate, keeled and ciliate scales at base: cone-scales not or slightly emarginate ... 10. *P. Abies*
            GG. Winter-buds resinous, their scales all obtuse, glabrous, revolute at apex: lower cone-scales deeply emarginate ..... 8. *P. heterolepis*
          FF. Cone 1¼–2½ inches long: leaves usually more or less glaucous, acute or obtusish, usually ⅓–⅗ inches long: bud-scales round and more or less revolute at apex, often emarginate ..... 19. *P. glauca*
      DD. Direction of leaves spreading more or less radially at nearly right angles.
        E. Winter-buds not or slightly resinous: leaves ½–1 inch long.
          F. Bud-scales more or less revolute at apex, light yellowish-brown: leaves in cross-section about as high as broad, usually bluish-green ..... 21. *P. pungens*
          FF. Bud-scales firmly appressed, dark brown: leaves higher than broad, bright green ..... 7. *P. polita*
        EE. Winter-buds very resinous: leaves ⅓–¾ inch long. 6. *P. Maximowiczii*
    CC. Branchlets pubescent.
      D. Terminal winter-buds without subulate scales.

E. Color of branchlets brown: leaves dark green: cone-scales rounded and entire at apex, stiff: cones 2–3 inches long.
F. All leaves pointed, ⅓–¾ inch long, spreading (see also 10, *P. Abies*).
G. Leading shoot glabrous or nearly so: leaves with more numerous stomata above than beneath. 14. *P. Koyamai*
GG. Leading shoot and other branchlets pubescent: leaves equally stomatiferous on all four sides. 11. *P. obovata*
FF. All leaves obtuse, very lustrous, ¼–½ inch long, more or less appressed. 12. *P. orientalis*
EE. Color of branchlets yellowish to grayish.
F. Length of leaves ½–¾ inch: cone with obovate, stiff entire scales.
G. Cone 3–5 inches long: leaves slender, slightly pungent, straight. 9. *P. asperata*
GG. Cone 2¼–3 inches long: leaves stout, usually curved, not pungent. 13. *P. Meyeri*
FF. Length of leaves ¾–1 inch, often glaucous: cone to 3 inches long, with rhombic, flexible erose scales. 20. *P. Engelmanni*
DD. Terminal winter-buds with a ring of conspicuous subulate scales at base: leaves often with fewer stomata beneath than above: cone 1¼–2¼ inches long.
E. Pubescence of branchlets non-glandular. 16. *P. Glehnii*
EE. Pubescence of branchlets glandular.
F. Cones green before maturity, falling soon after maturity: leaves lustrous green. 17. *P. rubra*
FF. Cones persisting for several years, purple before maturity: leaves glaucous or bluish-green. 18. *P. mariana*
BB. Leaf more or less compressed, in cross-section broader than high, with at least twice as many stomata above as beneath (see also 13, *P. Glehnii*).
C. Stomata of leaves about twice as many above as beneath: leaves slightly compressed.
D. Branchlets at least partly glabrous: bud-scales not acuminate.
E. Length of leaves ½–⅗ inch: leading branchlets glabrous or nearly so; the lateral ones glandular-pubescent. 14. *P. Koyamai*
EE. Length of leaves ¾–1 inch: the leading branchlets pubescent, the lateral ones glabrous. 15. *P. bicolor*
DD. Branchlets pubescent: lower bud-scales long-acuminate and keeled: cone with thin denticulate scales. 22. *P. montigena*
CC. Stomata of leaves of only 1 or 2 usually broken rows beneath: leaves distinctly compressed, with conspicuous bands above: cone with thin denticulate scales.
D. Apex of leaves acute or mucronate: cone brown or slightly purplish, with nearly rounded scales. 23. *P. Balfouriana*
DD. Apex of leaves obtuse or bluntly mucronate: cone purple, their scales attenuate above the middle and wavy . . . . 24. *P. purpurea*
AA. Leaves flattened with white bands above, without stomata beneath or occasionally only with a broken row.

BB. Direction of leaves not radially spreading, more or less pectinate below: branchlets short, not or slightly pendent.
C. Branchlets glabrous: cone-scales thin, erose-denticulate.
D. Leaf not pungent, though often pointed, ½–¾ inch long ..... 25. *P. jezoensis*
DD. Leaf pungent, rigid, ⅗–1 inch long ..... 26. *P. sitchensis*
CC. Branchlets pubescent or the leading shoots glabrescent: cone-scales stiff, appressed before maturity.
D. Color of branchlets yellow to orange-brown, the leading ones usually glabrescent: winter-buds without subulate scales at base: leaves usually without distinct green midrib above.
E. Leaf acutely pointed, often pungent, to ⅘ inch long .. 27. *P. complanata*
EE. Leaf obtusish or obtusely mucronulate.
F. Cone-scales broadly cuneate-obovate, rounded at apex: leaves ⅖–¾ inch long, and about $\frac{1}{16}$ inch broad ..... 28. *P. Sargentiana*
FF. Cone-scales rhombic, narrowed toward the truncate and erose apex: leaves about ¾ inch long, and about $\frac{1}{24}$ inch broad ..... 29. *P. ascendens*
DD. Color of branchlets brown, all pubescent: terminal winter-buds with subulate scales at base: leaves with distinct green midrib above ..... 30. *P. Omorika*
BB. Direction of leaves more or less radially spreading: branchlets long and pendulous.
C. Branchlets pubescent: leaves obtuse or obtusish, ¾–1 inch long, not keeled ..... 31. *P. Breweriana*
CC. Branchlets glabrous: leaves pungent, 1–1½ inches long, slender, keeled on both sides ..... 32. *P. spinulosa*

Section I. Eupicea, Willk. (*Morinda*, Mayr)

Leaves quadrangular, stomatiferous on all four sides: cone-scales firm, closely appressed before maturity, usually entire and rounded at apex.

1. **P. Smithiana,** Boiss. (*P. Morinda*, Link. *P. Khutrow*, Carr.). Himalayan S. Tree to 150 feet tall, with wide-spreading branches and slender pendulous branchlets; bark brownish-gray, shallowly fissured; branchlets gray, glabrous and lustrous; winter-buds ovoid, acute, up to ¼ inch long: leaves radially disposed, pointing forward, slender, usually higher than broad, acute, bright or dark green, ¾–2 inches long: fertile flowers purple: cones 5–7 inches long, dark brown and glossy; scales suborbicular, with entire margin, firm. Himalayas: Bhutan to Afghanistan.—Introduced to Europe in 1818. Hardy as far north as New York. A very handsome spruce; young trees are of broad-pyramidal habit with gracefully pendulous branchlets. The young growth starts very early and is liable to be injured by frost in spring, especially when planted in warm and damp situations.

2. **P. Schrenkiana,** Fisch. & Mey. (*P. obovata* var. *Schrenkiana*, Carr.). Schrenk S. Plate XXXII. Tree to 100 feet or more, with pendulous, gla-

brous gray branchlets; winter-buds subglobose, the terminal one with acuminate keeled and pubescent scales at base: leaves radially disposed, equally 4-sided, acute, dull dark green, ¾–1½ inches long, on young plants often slightly shorter: cones cylindric-ovate, 3–4 inches long; scales with entire margin. Central Asia.—Introduced to Europe about 1880 by A. Regel. Hardy as far north as Massachusetts. Similar in habit to the preceding species but branchlets little pendulous on younger plants and leaves shorter. A very desirable and hardy spruce.

3. **P. Watsoniana,** Mast. Watson S. Narrow-pyramidal tree to 60 feet tall, with slender short branches; winter-buds brown, not resinous, with obtuse closely appressed scales; branchlets glabrous, yellow or yellowish-gray, lustrous: leaves pointing forward, quadrangular, slender, ½–¾ inch long and scarcely $\frac{1}{24}$ inch wide, straight, acuminate or acute, dark green: cones cylindric-oblong, 1½–2 inches long, falling soon after maturity; scales obovate, entire, rounded or slightly and abruptly produced into a short point. Central and western China.—Introduced in 1901 by E. H. Wilson to Great Britain. Hardy as far north as Massachusetts and growing well. Remarkable for its very thin and slender leaves.

A closely related species is **P. morrisonicola,** Hayata. Tree to 140 feet tall, with brown scaly bark; winter-buds conic-ovoid, brown, slightly resinous; branchlets dull yellow to reddish, with prominent leaf-stalks: leaves slender, ⅓–¾ inch long, acuminate: cone ovoid-oblong, 2–2½ inches long; scales orbicular-obovate. Formosa.—Introduced by E. H. Wilson to the Arnold Arboretum in 1918. Probably tender.

4. **P. Wilsoni,** Mast. Wilson S. Pyramidal tree to 80 feet tall, with short spreading branches; branchlets glabrous, pale gray, with scarcely produced petioles; winter-buds ovoid, dark brown and lustrous: leaves quadrangular, stout, straight or curved, pungent, about ½ inch long, dark green: cones cylindric-oblong, 1¾–2½ inches long, persistent for about a year after maturity; scales suborbicular, entire, finally recurved at margin. Central China.—Introduced by E. H. Wilson to the Arnold Arboretum where it has proved hardy. A handsome spruce of dense habit with short, pungent, dark green leaves.

5. **P. aurantiaca,** Mast. Tree to 80 feet tall, spire-like, with short horizontal branches; bark pale gray to nearly white, exfoliating in thin plates; buds conical, resinous, with obtuse scales becoming more or less revolute at apex; branchlets glabrous, orange, often slightly bloomy, with prominent spreading petioles: leaves quadrangular, often curved, sharply pointed, ½–¾ inch long: cones cylindric, 4–5 inches long, with broad rounded, slightly erose scales. Western China.—Introduced in 1908 by E. H. Wilson to the Arnold Arboretum where it has proved hardy.

A closely related species is **P. retroflexa,** Mast. A taller tree differing

chiefly in the darker bark, brighter yellow lustrous branchlets, longer leaves less sharply pointed, and in the more lustrous, sometimes slightly pointed cone-scales. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum.

6. **P. Maximowiczii,** Regel (*P. Tschonoskii,* Mayr. *P. excelsa* var. *obovata japonica,* Beiss.). Japanese Bush S. Tree to 80 feet or occasionally to 120 feet tall, with horizontal branches ascending at the ends; branchlets glabrous, yellowish or reddish-brown; winter-buds small, resinous, with firmly appressed scales: leaves radially spreading, quadrangular, rigid and pungent, ⅓–⅗ inch long, dark green: cone oblong, 1½–2½ inches long, lustrous brown, green before maturity, with rounded entire scales. Japan.—Introduced in 1865 to Europe through the Petrograd Botanic Garden. Hardy as far north as Massachusetts and usually seen in cultivation as a small, compact, bushy tree.

7. **P. polita,** Carr. (*P. Torano,* Koehne. *P. Thunbergii,* Asch. & Graebn. *P. bicolor,* Hort., not Maxim.). Tigertail S. Tree to 90 feet tall, forming a dense broad pyramid, with rigid stout branches when young, older trees with the habit of *P. Abies,* with somewhat pendulous branches; young branchlets thick, glabrous, yellowish-brown; winter-buds blackish-brown, acute, ¼–⅗ inch long, with closely appressed scales: leaves radially spreading, rigid, higher than broad, often falcate, shining dark green, ½–1 inch long: fertile flowers green, staminate yellowish: cone oblong, 4–5 inches long, brown, glossy; scales broad, with finely denticulate margin. Japan.—Introduced in 1861 to Great Britain and the following year to America by Dr. G. R. Hall. Hardy to southern Ontario and New England. It is one of the most distinct spruces; of very striking appearance with its rigid spiny leaves spreading in all directions from the stout branches, but usually of rather irregular habit; also the conspicuous dark winter-buds are a feature of this species.

8. **P. heterolepis,** Rehd. & Wils. Tree to 80 feet tall; branchlets reddish or yellowish-brown, glabrous, with spreading prominent petioles; winter-buds large, ovoid, resinous, light brown, with obtuse scales revolute at apex: leaves quadrangular, stout, often slightly curved, abruptly spiny-pointed, ½–¾ inch long, bluish-green, often glaucescent: cone cylindric, 4–6 inches long, with rigid rhombic-ovate scales, the lower ones deeply emarginate at the apex. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved hardy.

9. **P. asperata,** Mast. Tree to 100 feet tall, with grayish-brown bark peeling off in thin flakes; branchlets pale yellowish-gray, pubescent, with often spreading or recurved petioles; winter-buds conical-ovoid, yellowish-brown: leaves quadrangular, often curved, ⅖–⅗ inch long, acute or acutish and beveled at the apex, dark green: cones cylindric-oblong, 3¼–4 inches long, fawn-gray when ripe, finally changing to chestnut-brown; cone-scales

usually rounded and entire at the apex. Western China.—Introduced together with the two following varieties in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved perfectly hardy and has shown itself one of the most vigorous of the Chinese spruces, in general appearance much resembling the Norway spruce.

Var. **notabilis,** Rehd. & Wils. Leaves ½–¾ inch long: cones 3½–5 inches long; scales rhombic-ovate, narrowed toward the apex.

Var. **ponderosa,** Rehd. & Wils. Bark thicker, brownish-gray; branchlets nearly glabrous, yellowish: cones 5–6 inches long.

71. Picea Abies.

10. **P. Abies,** Karst. (*P. excelsa,* Link. *P. rubra,* A. Dietr., not Link. *Pinus Abies,* L. *P. Picea,* Dur.). Norway Spruce. Fig. 71 and Plate XXXIII. Tree to 150 feet tall, with spreading branches and usually pendulous branchlets; bark reddish-brown; young branches brown, glabrous or pubescent; winter-buds reddish or light brown, without resin, the terminal bud at base with a few acuminate keeled pubescent scales: leaves quadrangular, acute, dark green and usually shining, ½–¾, rarely to 1 inch long: staminate and fertile flowers bright purple: cones cylindric-oblong, 4–7 inches long, light brown; scales rhombic-ovate, emarginate or truncate at apex, with erose-denticulate margin. Middle and northern Europe, east to the Ural Mountains.—Early introduced to this country where it is hardy as far north as Saskatchewan. It is extensively planted as an ornamental tree in the northern and eastern States; it is of rapid growth and is a handsome tree with its graceful habit and dark green dense foliage, but, like many spruces and firs, loses much of its beauty when it grows old, and usually after thirty years it becomes thin and ragged in the top. It is one of the best conifers to plant for shelters and windbreaks. The Norway spruce is very variable, and a great number of garden forms are in cultivation. Some of the more important are the following:

Forms differing in color or shape of leaves: Var. **argentea,** Rehd. (*P. excelsa variegata,* Beiss.). Leaves variegated with white. Var. **argenteo-spica,** Rehd. (*P. excelsa argenteo-spica,* Hesse, or *argenteo-spicata,* Beiss.).

Silver Norway S. A form with the tips of the young branchlets white. Var. **aurea,** Nash (*P. excelsa aurea,* Carr.). Golden Norway S. Leaves golden-yellow on the exposed side; does best in a partly shaded situation. Var. **finedonensis,** Nash (*P. excelsa finedonensis,* Beiss. *Abies excelsa finedonensis,* Gord.). Finedon S. Leaves pale yellow at first, becoming bronzy brown and finally green. Var. **cincinnata,** Rehd. (*P. excelsa cincinnata,* Hesse). Branchlets pendulous: leaves long and comparatively broad, curved upward and spirally twisted. A very peculiar form.

Forms of narrow pyramidal or columnar habit: Var. **pyramidata,** Rehd. (*P. excelsa pyramidata,* Carr. *P. excelsa pyramidalis,* Voss. *P. excelsa* l. *erecta,* Schroet.). Pyramidal Norway S. The branches ascending at a very acute angle, the lower ones very long, decreasing toward the apex, forming a narrow slender pyramid. Var. **cupressina,** Rehd. (*P. excelsa* l. *cupressina.* Thomas). Tree with ascending densely ramified branches forming a dense broad column. Var. **columnaris,** Rehd. (*P. excelsa columnaris,* Carr.). With very short horizontal or slightly pendent much ramified branches, forming a narrow column.

Pendulous or sparingly branched forms: Var. **pendula,** Nash (*P. excelsa* var. *pendula* Jacq. & Herincq. *P. excelsa reflexa,* Carr.). Weeping Norway S. Plate XXXIV. With pendulous branches and branchlets; whorls of branches often irregular. Var. **inversa,** Nash (*P. excelsa inversa,* Beiss. *Abies excelsa inverta,* Gord.). Similar to the preceding, but branches more closely appressed to the stem, more densely branched, with thick lustrous leaves. Var. **viminalis,** Th. Fries (*P. excelsa* var. *viminalis,* Casp.). Branches in remote whorls, almost horizontal, with very long and slender branchlets without or with very few lateral branchlets. Var. **virgata,** Th. Fries (*P. excelsa* var. *virgata,* Casp. *P. excelsa denudata,* Carr.). Sparingly branched, with long and slender branches destitute of branchlets, spreading, usually the lower ones pendulous and the upper ones ascending. Var. **monstrosa,** Rehd. (*P. excelsa* l. *monstrosa,* Regel. *P. excelsa* var. *monocaulis,* Nördl. *Abies excelsa monstrosa,* Loud.), is an extreme form of the preceding and is destitute of all branches; it consists only of a single stem clothed with thick rigid leaves.

Low forms of irregular habit more or less monstrous: Var. **Barryi,** Nash (*P. excelsa Barryi,* Beiss.). Barry S. With vigorous thick branches and few short branchlets, dark green.

Low pyramidal to subglobose or depressed forms: Var. **conica,** Th. Fries (*P. excelsa conica,* Carr.). Arrowhead Norway S. A dense conical pyramid with ascending branches and very crowded slender, light brown branchlets: leaves radially arranged, thin and pointed; light green. Var. **elegans,** Rehd. (*P. excelsa elegans,* Beiss.). Knight S. A dense conical form similar to the preceding, with short crowded branchlets densely covered with short radially arranged leaves. Var. **mucronata,** Rehd. (*P. excelsa mucronata,* Carr. var.

Clanbrasiliana, Hort., not Carr. var. *Gregoryana*, Hort., not Gord.). Strong-growing pyramidal shrub with ascending or sometimes spreading branches and branchlets; branchlets very crowded, stout, bright red-yellow: leaves very crowded, stout, abruptly sharp-pointed, dark lustrous green. Var. **Remontii,** Rehd. (*P. excelsa Remontii*, Beiss.). An ovoid to globose or conical form of slow growth with crowded light yellow thin branchlets and fine radially spreading light green leaves. Var. **Ellwangeriana,** Rehd. (*P. excelsa Ellwangeriana*, Beiss.). A pyramidal round bush of vigorous growth and somewhat loose habit with stout bright orange branchlets and bright, dark green stiff leaves ¾ inch long and gradually tapering to a sharp point. Var. **compacta,** Nash (*P. excelsa compacta*, Beiss.). Globe Norway S. A subglobose dense form with slender branchlets and acute short leaves. Var. **parviformis,** Rehd. (*P. excelsa parviformis*, Otto. *Abies excelsa parviformis*, Maxw.). A broadly pyramidal form with thin regular branchlets and very short thin pungent leaves of bright green color. Var. **pygmæa,** Rehd. (*P. excelsa pygmæa*, Carr.). Pygmy Norway S. A very dense, small conical form with crowded and irregular, ascending, short whitish branchlets and bright or dark green, radially spreading short leaves. Var. **Merkii,** Rehd. (*P. excelsa Merkii*, Beiss.). Merk S. A low and dense, broad round form growing finally into a broad pyramid; branchlets rather fine, yellowish-white, irregularly arranged: leaves very thin, ½ inch long, tapering to a fine hair-like point, lustrous grass-green, crowded above and pointing forward, pectinate below. Var. **pumila,** Nash (*P. excelsa pumila*, Beiss. *Abies excelsa pumila*, Maxwell). A dwarf depressed-globose, densely branched form with red-brown thick and stiff, spreading branchlets: leaves thin, short, ⅜ inch long, tapering to a blunt point, lustrous dark green or bluish-green (var. "*pumila glauca*," Beiss.). Var. **Clanbrasiliana,** Th. Fries (*P. excelsa Clanbrasiliana*, Carr. *Abies excelsa Clanbrasiliana*, Loud.). Plate XXXIV. A compact, roundish, rather flat-topped bush rarely exceeding 6 to 7 feet, with very short and crowded thin whitish branchlets: leaves nearly radial and pointing forward or pectinate on under side of branchlets, thin, ⅛–⅜ inch long, tapering to a very fine point, lustrous bright green. (Named after Lord Clanbrasil of Ireland who introduced the plant into cultivation.) Var. **Gregoryana,** Nash (*P. excelsa Gregoryana*, Beiss. *Abies excelsa Gregoryana*, Gord.). Gregory S. A very dwarf form, conical or subglobose, rarely exceeding 2 feet in height, with short crowded spreading branches and very crowded thin, whitish to grayish-brown branchlets slightly pubescent in the grooves: leaves radially arranged, irregular in direction, ¼–½ inch long, pale gray-green. Var. **Veitchii,** Rehd. (*P. excelsa Gregoriana* f. *Veitchii*, Hornibrook). Similar to the preceding, but less compact and more conical, with more vigorous branchlets to 1½ inches long and inclined to droop: leaves radial and stiff on the leading shoots, thinner and flatter and more pectinately arranged on the lateral branchlets. Var. **Parsonsii,** Rehd.

(*P. excelsa Gregoriana* f. *Parsonsii*, Hornibrook. *P. excelsa Clanbrasiliana*, Parsons, not Carr.). Similar to var. *Gregoryana*, but of loose more straggling habit, with spreading branches and pendulous branchlets: leaves thinner and flatter, more distant, pectinately arranged. Var. **Maxwellii,** Nash (*Abies excelsa Maxwellii*, R. Smith, not *P. excelsa Maxwellii*, Beiss.). A low, flat, dense form, not exceeding 2 feet in height with very short and thick, whitish to yellow-brown branchlets and light green radially arranged leaves tapering to a fine hair-like point. Var. **nana,** Nash (*P. excelsa nana*, Carr.). A depressed-globose or sometimes conical form with very crowded ascending branches and short orange-yellow branchlets, sometimes swollen and monstrous with larger and stouter leaves and large buds: leaves radially arranged, rather distant and nearly appressed, about ½ inch long, stiff, abruptly tapering to a sharp point. Var. **procumbens,** Rehd. (*P. excelsa procumbens*, Carr.). Prostrate Norway S. A prostrate form with horizontal branches and numerous stiff bright yellow branchlets in flat layers: leaves pointing forward, yellow-green, thin and flat, ¼–½ inch long, pointed. Var. **tabuliformis,** Th. Fries (*P. excelsa tabuliformis*, Carr.). A low flat form with horizontally spreading branches and rather distant, thin, yellow-brown branchlets: leaves pointing slightly up and forward, yellow-green, very thin, ¼–⅓ inch long, blunt. Var. **microsperma,** Rehd. (*P. excelsa* var. *microsperma*, Hornibrook). Plate XXXIV. A dense, compact, conical or round bush with much crowded and ascending branches and branchlets, the latter gray-brown: leaves light bright green, close-set and pointing forward, thick, slightly curved and blunty pointed, about ½ inch long.

There are two forms of the Norway spruce differing in the color of the young cone: Var. **chlorocarpa,** Th. Fries (*P. excelsa* var. *chlorocarpa*, Purk.). Young cones green: leaves obtusish, more or less appressed; leafing later. Var. **erythrocarpa,** Rehd. (*P. excelsa* var. *erythrocarpa*, Purk.). Young cones violet-purple: leaves more or less spreading; leafing earlier.—A form occasionally found wild in central and northern Europe is var. **nigra,** Th. Fries (*P. excelsa* var. *nigra*, Willk. *Abies excelsa* var. *nigra*, Loud.). Densely branched pyramidal form with crowded falcate, obtusish, dark green leaves.

11. **P. obovata,** Ledeb. (*P. excelsa* var. *obovata*, Blytt. *P. Abies* var. *obovata*, Voss). Tree to 100 feet, similar in habit to the following species, with somewhat pendulous branchlets brown when young and minutely pubescent; winter-buds conical with closely appressed scales, the terminal bud at base with acuminate keeled ciliate scales: leaves quadrangular, slightly higher than broad, acute, ½–¾ inch long, dull or bluish-green: female flowers purple: cone oblong-ovoid, about 2½ inches long, light brown; scales broad and rounded at apex, entire. Northern Europe and northern Asia to Kamchatka and Manchuria.—Hardy as far north as Canada and probably to Saskatchewan. A smaller, slow-growing and more graceful tree than the

Norway spruce, with pendent branchlets; grows best in colder and mountainous regions, but is little known in cultivation.

Var. **fennica,** Henry (*P. excelsa* var. *fennica*, Schroet. var. *medioxima*, Willk.). Leaves dark green: cone-scales rounded, finely denticulate. Northern Europe.

Var. **alpestris,** Henry (*P. excelsa* var. *alpestris*, Bruegg.). Slow-growing compact tree; young branchlets densely short-pubescent: leaves obtuse or acutish, ½–⅔ inch long, bluish- or grayish-green: cones 3–5 inches long. Resembles in habit and foliage somewhat *P. glauca*. European Alps at high altitudes.

12. **P. orientalis,** Carr. ORIENTAL S. Fig. 72. Plate XXXII. To 100 or even to 150 feet tall, with ascending and spreading branches and somewhat pendulous branchlets; bark brown, scaly; branchlets brown, pubescent; winter-buds acute, brown, the terminal bud at base with a few acuminate keeled scales: leaves thick, obtuse, ¼–⅝ inch long, dark green and shining, crowded and more or less appressed to the branches: flowers carmine: cone cylindric-ovate, 2½–3½ inches long, less than 1 inch thick; scales orbicular, entire at the margin. Caucasus, Asia Minor.—Introduced into Europe in 1837. Hardy as far north as southern Ontario and New England. A very graceful spruce with dark glossy foliage; of slow growth and therefore valuable for smaller gardens. It holds its lower limbs for many years.

72. Picea orientalis.

Var. **aureo-spicata,** Beiss. YELLOWTIP ORIENTAL S. Young leaves yellow, changing later to green.

Var. **nana,** Carr. (var. *compacta*, Hort.). Low form of broadly pyramidal habit, with wide-spreading branches.

13. **P. Meyeri,** Rehd. & Wils. Medium-sized tree; branchlets yellowish or light brown, densely pubescent or rarely nearly glabrous, often densely pubescent one year and the continuation of the same branch glabrescent the following year; winter-buds conical, light brown, resinous, the scales at the base of the terminal bud acute and pubescent: leaves quadrangular, obtusish, often curved, ⅓–¾ inch long, bluish-green: cone cylindric-oblong, 2½–3 inches long, lustrous brown, with obovate rounded scales. Northern China.—Introduced in 1910 by Wm. Purdom to the Arnold Arboretum where it has proved hardy.

14. **P. Koyamai**, Shiras. (*P. Moramomi*, Hort.). Narrow pyramidal tree to 60 feet tall; bark grayish-brown, scaly, peeling off in thin flakes; branchlets reddish-brown and slightly bloomy, the lateral ones glandular-pubescent, the leading shoots nearly glabrous; winter-buds conical, brown, resinous: leaves quadrangular, slightly compressed, straight or curved, acute or obtuse, ⅓–½ inch long, the white bands above each with 5–8 rows of stomata, those beneath with 2–4 rows each and inconspicuous: cones cylindric-oblong, 2–4 inches long, pale brown, pale green before maturity; scales broad, rounded, denticulate, very firm. Japan.—Introduced in 1914 by E. H. Wilson to the Arnold Arboretum where it has proved hardy.

15. **P. bicolor**, Mayr (*P. Alcockiana*, Carr., partly. *P. Alcockiana nova*, Hort. *Abies bicolor*, Maxim.). Alcock S. Plate XXXV. Pyramidal tree 80–150 feet tall, with rather stiff, spreading or ascending branches; bark grayish-brown, fissured into thin plates; young branches dull yellowish-brown, glabrous, usually only leading shoots pubescent; winter-buds conic-ovoid, brown, slightly resinous: leaves quadrangular, slightly compressed from above, somewhat curved, with 2 bluish-white bands above, dark green beneath and with only 2–4 rows of stomata on each side, sharply acuminate, ½–¾ inch long: cones oblong, brown, purple before ripening, 3–4 inches long; scales obovate, finely denticulate and slightly wavy at the often recurved margin. Japan.—Introduced in 1861 and again in 1868 to Europe. Hardy as far north as southern Ontario and New England. A handsome tree growing well in the eastern States.

16. **P. Glehnii**, Mast. Saghalin S. Tree to 120 feet tall, of narrow-pyramidal habit with slender, short and spreading branches; bark red-brown, fissured into thin flakes; branchlets reddish-brown, densely short-pubescent; winter-buds conic-ovoid, chestnut-brown, resinous, the terminal bud at base with subulate scales: leaves quadrangular, slightly compressed, obtuse or on young plants pointed, ¼–½ inch long, deep green, with 2 rows of stomata on each side above and with 1 row on each side beneath: cones cylindric-oblong, 2–3 inches long, lustrous brown, violet before maturity; scales suborbicular, rounded or slightly produced in the middle, entire or slightly erose. Japan and Saghalin.—Introduced before 1891 to Europe and in 1894 to the Arnold Arboretum where it is perfectly hardy and has grown into handsome narrow-pyramidal trees. Probably hardy as far north as Canada.

73. Picea rubra.

17. **P. rubra**, Link, not A. Dietr. (*P. australis*, Small. *P.*

rubens, Sarg.). Red S. Fig. 73. Tree to 100 feet tall, with short and slender branches forming a narrow pyramidal head and with red-brown bark; branchlets reddish-brown, pubescent; winter-buds ovoid, acute, the terminal bud at base with subulate pubescent scales: leaves quadrangular, acute or mucronate, dark or bright green, shining, about ½ inch long: flowers purple: cones oblong, 1¼–2 inches long, green while young, later light reddish-brown, glossy; scales obovate, rounded and entire or slightly erose at the margin. From Canada to the high mountain peaks of North Carolina.—Introduced to Europe in 1755. Hardy probably as far north as Saskatchewan. It is a handsome tree of narrow-pyramidal habit, but it requires a cool and moist situation and is less drought-enduring than most other species.

Var. **virgata,** Rehd., is a sparingly branched form with long and slender branches destitute of branchlets, very similar to *P. Abies* var. *virgata.*

18. **P. mariana,** BSP. (*P. nigra,* Link. *P. brevifolia,* Peck). The native Black S. Tree usually to 20–30 or occasionally to 100 feet tall, with slender often pendulous branches forming a narrow irregular head; bark gray-brown; branchlets brown or yellowish-brown, pubescent: leaves quadrangular, often slightly compressed from above, obtusish, dull dark or bluish-green, bloomy especially on the upper side, ¼–¾ inch long, stomatic bands above usually somewhat broader than those beneath: flowers purple: cones oval-oblong, globose-ovoid when open, dark purple while young, later dull grayish-brown, ½–1½ inches long; scales rounded and finely denticulate at the margin. From Labrador to Alaska and south to Wisconsin and Michigan and in the mountains to West Virginia.—Introduced about 1700 to Europe. Hardy as far north as Labrador and Saskatchewan. Very variable in habit; when growing in swamps, plants only a few feet high may bear cones; usually of rather thin and irregular habit.

The most ornamental garden form is var. **Doumetii,** Sudw. (*P. nigra Doumetii,* Carr.). Doumet S. With ascending crowded branches forming a dense conical pyramid. A similar form, somewhat broader at the base with more light bluish-green foliage, is var. **Beissneriana,** Rehd. (*P. nigra mariana,* Beiss.).

Var. **ericoides,** Rehd. (*P. ericoides,* Mast.). A pyramidal, loosely branched bush of slow growth with short, finely pointed, bluish-green leaves; the leading shoots glabrescent towards the apex.

Var. **fastigiata,** Rehd. (*P. nigra fastigiata,* Carr. *Abies nigra pumila,* Knight). Pyramidal Black S. A columnar form with ascending branches and short, acute leaves.

19. **P. glauca,** Voss (*P. canadensis,* BSP., not Link. *P. alba,* Link. *P. laxa,* Sarg.). White S. Plate XXXVI. Tree to 60 or 70, rarely to 120 feet tall, with ascending branches and usually pendent branchlets; bark grayish,

scaly; branchlets glabrous, grayish- or pale-brown; winter-buds ovoid, obtuse, with glabrous, usually loosely imbricated scales, rounded and bifid at the apex: leaves quadrangular, acute or acutish, slightly curved, ⅓–¾ inch long, more or less bluish-green, of strong disagreeable odor when bruised: cones cylindric-oblong, 1½–2 inches long, pale brown and lustrous, green before maturity; scales suborbicular, with rounded entire margin. Labrador to Alaska, south to Montana, Minnesota, and New York.—Introduced about 1700 to Europe. Hardy as far north as Labrador and Saskatchewan. An ornamental species of dense habit when young and with rather light bluish-green foliage; it endures heat and drought much better than the two preceding species.

Var. **cærulea,** Rehd. (*P. canadensis cærulea*, Schneid. *P. alba cærulea*, Carr. *P. alba argentea* and var. *glauca*, Hort. *Abies rubra violacea*, Loud.). Silver White S. Of dense habit, with light bluish-green or almost silvery-white leaves. Var. **aurea,** Rehd. (*P. alba aurea*, Beiss.). Golden White S. With golden-yellow foliage.

An important geographical variety is var. **albertiana,** Sarg. (*P. canadensis* var. *albertiana*, Rehd. *P. albertiana*, S. Br. *P. alba albertiana*, Beiss.). Alberta S. Tree to 100 or occasionally 150 feet, of narrow-pyramidal habit; branchlets sometimes minutely pubescent; winter-buds slightly resinous, with entire scales, the basal ones acuminate: leaves more crowded; leaf-cushions longer: cones shorter, with more rigid, rounded, slightly denticulate scales. British Columbia to Wyoming and Montana.—Introduced in 1906 by J. M. Macoun. The "Black Hills" spruce belongs here; it is said to be a very compact pyramidal tree of slow growth. Var. **conica,** Rehd. (*P. albertiana*, Hort., not S. Br.). A dwarf form of the preceding variety of dense, narrow-conical habit, with radially spreading, thin, slender leaves ⅓–½ inch long. Introduced in 1904 to the Arnold Arboretum by J. G. Jack.

Section II. Casicta, Mayr.

Leaves quadrangular or compressed and with few rows of stomata on the lower side or none: cone-scales loosely appressed before maturity, at maturity thin and flexible, usually rhombic, with erose and more or less wavy margin.

20. **P. Engelmanni,** Engelm. (*P. columbiana*, Lemmon. *P. pseudopungens*, Dieck. *Abies commutata*, Murr.). Engelmann S. Fig. 74 and Plate XXXVII. Tree to 150 feet tall, with slender spreading branches in closely arranged whorls, forming a dense and narrow pyramid in young trees; winter-buds with brownish-yellow, usually appressed or little spreading scales; branchlets pale brownish-yellow, pubescent: leaves more or less directed forward, slender, straight or slightly incurved, acute, bluish-green to steel-blue, ½–1 inch long, without resin-canals, of a strong aromatic odor when

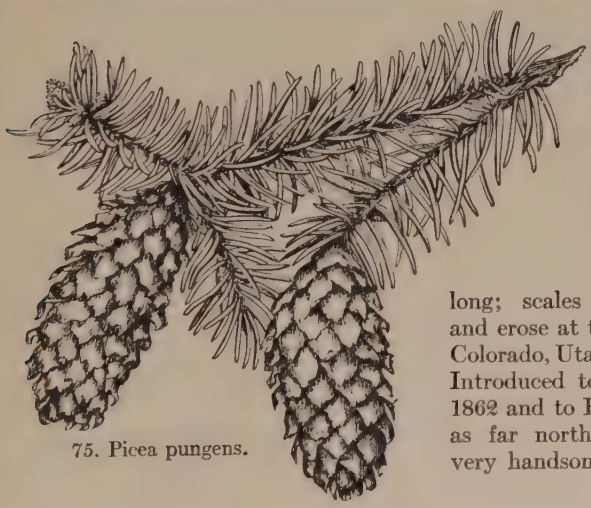
bruised: flowers purple: cones oval- to cylindric-oblong, light brown, 1½–3 inches long; scales thin and flexible, rhomboidal, narrowed and truncate or rarely acute at the erose-denticulate apex. British Columbia and Alberta to Oregon, Arizona and New Mexico.—Introduced in 1862 to the eastern States and in 1864 to Europe. Hardy as far north as Saskatchewan. A very ornamental tree varying in the color of its foliage.

74. Picea Engelmanni.

Var. **glauca,** Beiss., has bluish or steel-blue, and var. **argentea,** Beiss., silvery-gray foliage.

Var. **Fendleri,** Henry, has pendulous branchlets and longer and slenderer leaves often slightly exceeding 1 inch in length, with 4 rows of stomata on each side above and half as many beneath. Supposed to have come from New Mexico.

21. **P. pungens,** Engelm. (*P. Parryana,* Sarg. *Abies Menziesii,* Engelm., not Lindl.). Colorado S. Fig. 75. Well-known variable tree 80–100, or occasionally to 150 feet, with horizontal stout branches in rather remote whorls, forming a broad regular pyramid; winter-buds with brownish-yellow usually reflexed scales; branchlets glabrous, bright yellowish-brown: leaves more or less radially spreading, quadrangular, rigid, incurved, spiny-acuminate, bluish-green to silvery-white or rarely dull green, ¾–1⅗ inches long, with 2 resin-ducts: cones cylindric-oblong, light brown and glossy, 2½–4 inches long; scales rhomboidal, narrowed and erose at the apex. Wyoming to Colorado, Utah, and New Mexico.—Introduced to the eastern States in 1862 and to Europe in 1877. Hardy as far north as Saskatchewan. A very handsome tree of symmetrical



75. Picea pungens.

habit, with light colored, sometimes almost silvery-white foliage. Very popular as a lawn tree and for dry climates one of the best of all spruces.

Var. **viridis,** Regel (*P. commutata,* Hort., not Murr.). The typical form with green leaves.

Var. **glauca,** Beiss. Blue Colorado S. With bluish foliage. Var. **cærulea,** Beiss. With bluish-white foliage. Var. **argentea,** Beiss. (var. *pungens Kosteri,* Beiss. var. *Kosteriana,* Hort.). With bluish-white foliage.

Var. **Kosteriana,** Mast. (*P. pungens glauca pendula,* Beiss.). With bluish-white foliage and pendulous branches.

Var. **compacta,** Rehd. A dwarf compact form; originated at the Arnold Arboretum about 1877.

22. **P. montigena,** Mast. Tree to 100 feet tall, with rather long horizontally spreading branches ascending at the ends; branchlets yellow or pale brown, hairy; winter-buds ovoid, acute, resinous, the lower scales of the terminal bud acuminate and keeled: leaves quadrangular, slightly compressed, rhombic in section, obtuse or acutish, curved, obtusely keeled above, ⅓–½ inch long, with 2 white bands above, each with about 5 rows of stomata, those beneath inconspicuous, with 2–3 rows each: cones cylindric-oblong, 3–4 inches long, cinnamon-brown, with rhombic-ovate, thin, erose scales. Western China.—Introduced by E. H. Wilson in 1908 to the Arnold Arboretum where it has proved hardy.

23. **P. Balfouriana,** Rehd. & Wils. Tree to 120 feet tall, with short horizontal branches; bark gray, deeply furrowed into thick irregular plates; branchlets densely villous, yellowish or yellowish-gray, with spreading villous petioles ¼ inch long; winter-buds broadly ovoid or conical, brown, slightly resinous, with appressed scales: leaves quadrangular, compressed, straight or slightly curved, acutish or obtuse, ⅓–⅗ inch long, with 2 white bands above, those beneath inconspicuous and with only 1–4 rows of stomata: cones ovoid-oblong, 2½–3½ inches long, violet-purple; scales brownish on back, striate toward the apex, flexible, rhombic-ovate, often contracted below the apex and produced into a point, erose above the middle and usually laciniate and wavy. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved hardy and seems promising.

24. **P. purpurea,** Mast. Tree to 60 feet tall, with wide-spreading branches; bark dark gray, fissured and separating in thin scales; branchlets orange-yellow, densely pubescent, with short spreading petioles; winter-buds broadly ovoid, resinous, with appressed scales: leaves quadrangular, more or less compressed, curved, obtuse or acutish, with 2 white bands above, green beneath, usually with 2 incomplete rows of stomata, ⅓–½ inch long: cones cylindric-oblong, 2–2½ inches long, purple, more or less so even at maturity; scales rhombic-oblong, contracted, narrowed from about the middle, erose-denticulate, acutish or truncate at the apex. Western China.—Introduced

in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved hardy. The fruiting tree will prove certainly very ornamental with its numerous purple cones.

A closely related species is **P. likiangensis,** Pritz. Tree to 100 feet tall; branchlets pale yellow, pubescent, with spreading petioles about $\frac{1}{2}$–$\frac{1}{4}$ inch long: leaves acute or mucronate, beneath with 1 or 2 often incomplete rows of stomata on each side: cone cylindric-oblong, about $3\frac{1}{2}$ inches long, with rhombic-ovate thin scales denticulate and nearly rounded at apex. Western China.—Introduced to Europe between 1900 and 1910. The related *P. hirtella,* Rehd. & Wils., is not in cultivation.

25. **P. jezoensis,** Maxim. (*P. ajanensis,* Fisch. *Abies jezoensis,* Sieb. & Zucc. *Abies Alcockiana,* Veitch, partly). Yeddo S. Tree 100–150 feet tall or occasionally higher, with horizontally spreading slender branches; bark dark gray, scaly, deeply fissured in old trees; branchlets glabrous, shining, yellowish-brown or yellowish-green, the leaf-cushions slightly swollen, with usually recurved petioles; winter-buds conical, resinous, lustrous: leaves compressed, slightly curved, acute, slender, slightly ridged on both sides, dark green and shining below, silvery-white above, $\frac{1}{2}$–$\frac{3}{4}$ inch long: flowers carmine: cones oblong, light brown, $1\frac{1}{2}$–$3\frac{1}{2}$ inches long; scales thin and flexible, oval-oblong, erose. Northeastern Asia to northern Japan.—Introduced in 1878 by Charles Maries.

Var. **hondoensis,** Rehd. (*P. hondoensis,* Mayr. *P. ajanensis* var. *microsperma,* Beiss., not Mast.). Hondo S. Plate XV. To 100 feet; branchlets light reddish-brown with much swollen leaf-cushions: leaves shorter, more obtuse, dull green below. Central Japan.—Introduced to England by Veitch in 1860. It is hardy as far north as Massachusetts and is a handsome ornamental tree of broad-pyramidal habit and bright green dense foliage. The typical form is rarely cultivated and is not doing well in the eastern States; it is of thinner habit and is liable to suffer from late frosts on account of its early leafing.

A hybrid between *P. jezoensis* and *P. mariana* is **P. Moseri,** Mast. Branchlets smooth, olive-brown: leaves quadrangular, acute, $\frac{1}{2}$–$\frac{3}{4}$ inch long, slightly compressed, glaucous above, green beneath. Originated in France sometime before 1900.

26. **P. sitchensis,** Carr. (*P. sitkaënsis,* Mayr. *Abies Menziesii,* Lindl.). Sitka S. (Tideland S.). Tree usually 100, occasionally 200 feet high, with, slender horizontal branches, forming a broad pyramid in young trees; in old trees the upper branches short and ascending, the lower ones slender and spreading, clothed with slender branchlets; bark bright or dark red-brown; branchlets rigid, light brownish-yellow, glabrous; winter-buds conical, acutish, light brown, resinous, the terminal bud at base with a few acuminate scales: leaves bright green, shining and rounded on the lower side, flat,

slightly ridged and silvery-white on the upper side, sharply acute or acuminate, ½–1 inch long: staminate flowers red: cones cylindric-oval, pale yellowish- or reddish-brown, 2½–4 inches long; scales rounded at the apex and erose; bracts visible between the scales. Alaska to California.—Introduced to Europe in 1831. In the eastern States it is not thriving, as it cannot stand the hot and dry summer; it is probably not hardy north of New York. Where it grows well, it is a highly ornamental tree, especially attractive on account of the contrasting colors of its leaves.

Var. **speciosa,** Beiss., is of slower growth and more compact habit, with more ascending branches and shorter, more rigid leaves.

Section III. Omorica, Wilk.

Leaves more or less compressed, with glaucous lines above, green below: scales of cone closely appressed before maturity, broad and entire or nearly so on the margin.

27. **P. complanata,** Mast. Tree to 80 feet tall, with horizontal branches and short pendulous branchlets; bark pale gray, comparatively smooth, on older trees darker and fissured; branchlets orange-brown, pubescent or the leading shoots glabrescent, with swollen pulvini and very short petioles; winter-buds dark brown, ovoid, acutish: leaves compressed, abruptly acuminate and often pungent, ½–⅘ inch long, with broad white bands above, green and keeled beneath: cones cylindric-oblong, 5–6½ inches long, with broad, rounded or truncate scales; bracts long-acuminate. Western China.—Introduced in 1903 to England by E. H. Wilson and in 1908 to the Arnold Arboretum where it has proved hardy only in sheltered positions.

28. **P. Sargentiana,** Rehd. & Wils. Sargent S. Tree to 75 feet tall, with spreading, slightly pendent branches; bark grayish-brown, fissured into irregular plates; branchlets at maturity orange to pale yellow, the weaker ones more or less stipitate-glandular, the stronger shoot usually glabrous, with short slightly recurved petioles; winter-buds conspicuous, dark brown, conic-ovoid, acutish to obtusish: leaves compressed, curved, acutish or obtuse, ⅖–⅗ inch long and about 1/16 inch broad, with 2 broad white bands above, green and lustrous beneath, keeled on both sides: cones oblong-cylindric, 2½–5 inches long, often persisting one year after maturity; scales firm, broadly cuneate-obovate, rounded or truncate at apex, spreading at maturity; bracts minute, rounded at apex. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it has proved hardy only in sheltered positions.

29. **P. ascendens,** Patschke. Pyramidal tree to 80 feet tall, with horizontally spreading branches upturned at the ends and with slender pendent branchlets; branchlets pale brown, setosely hairy or the stronger shoots

glabrous or glabrescent; winter-buds dark brown, ovoid or obtusish: leaves compressed, acutish or obtusely mucronulate, ½–¾ inch long, with 2 broad white bands above, green and keeled beneath: cones cylindric-oblong, 3–4 inches long; scales rhombic, narrowed toward the truncate or emarginate erose apex; bracts linear-oblong, obtuse, 4–5 times shorter than scale. Western China.—Introduced in 1910 by E. H. Wilson to the Arnold Arboretum where it has, like the two preceding species, proved hardy only in sheltered positions. All three species will probably be very ornamental in suitable localities, but the plants have not yet attained sufficient size to allow a definite opinion.

A closely related species is **P. brachytyla,** Pritz. (*P. pachyclada*, Patschke). Tree to 80 feet tall; bark dark brown, deeply fissured; branchlets nearly glabrous, with prominent pulvini: leaves about ½ inch long: cones 3–4 inches long, with obovate scales entire at the margin. Central China.—Introduced by E. H. Wilson to England in 1901.

30. P. Omorika, Bolle (*Pinus Omorika*, Pancic). Servian S. Fig. 76. Plate XXXII. To 100 feet or higher, with rather short spreading and ascending branches and short pendent branchlets forming a narrow pyramidal head; bark brown, separating into thin plates; branchlets brown, pubescent; winter-buds dark brown, not resinous: leaves compressed, obtuse and mucronulate, dark green and shining below, with whitish bands above, ⅓–½ inch long, keeled on both sides: flowers purple: cones ovoid-oblong, cinnamon-brown, glossy, 1½–2½ inches long; scales almost orbicular, very convex, with finely denticulate margin. Southeastern Europe.—Discovered in Serbia in 1872 and introduced into cultivation about 1880. Hardy as far north as southern Ontario and New England and possibly farther north. A desirable ornamental tree of dense narrow-pyramidal habit when young; one of the best spruces for the northeastern States.

76. Picea Omorika.

31. P. Breweriana, Wats. Tree 80–120 feet high, with the branches at the top slightly ascending, the lower ones horizontal or pendulous, with whip-like pendulous branchlets often 7 to 8 feet long, furnished with similar slender lateral branchlets; branchlets reddish-brown, pubescent; winter-buds conical, chestnut-brown: leaves radially spreading, straight or slightly curved, obtuse, rounded and dark green at the lower surface, almost flat and with white bands above, ¾–1 inch long: staminate flowers purple: cones oblong,

2½–5 inches long, light orange-brown; scales obovate, with entire margin. Siskiyou Mountains of southern Oregon and northern California.—First introduced into cultivation in 1893. Hardy in sheltered positions as far north as Massachusetts; it does not seem to take kindly to cultivation and only a few rather small trees are known to exist in Europe and in the eastern States. In its native habitat it is a handsome tree remarkable for its pendulous whip-like branches.

32. **P. spinulosa,** Henry (*P. morindoides*, Rehd.). Tree to 150 feet tall, with spreading branches and slender pendulous branchlets; branchlets glabrous, yellowish-gray; winter-buds ovoid, obtuse, scarcely resinous: leaves imperfectly radially arranged, slightly compressed, slender, straight or slightly curved, acute and pungent, ¾–1½ inches long, with 2 glaucous bands above, green beneath, keeled on both sides: cones cylindric-oblong, 2½–4 inches long, with suborbicular scales, entire or slightly denticulate and undulate at the margin. Himalayas: Bhutan and Sikkim.—Introduced about 1878 to Europe. Little known in this country and probably not hardy north of the Middle Atlantic States; at the Arnold Arboretum young plants did not survive the first winter. A distinct and graceful spruce somewhat similar in habit to *P. Smithiana*, but slenderer and thinner.

25. PSEUDOLARIX, Gord. GOLDEN-LARCH

Deciduous resinous tree with horizontally spreading whorled branches: leaves linear, in dense clusters on short spurs, those of the young shoots spirally arranged: flowers monœcious, staminate flowers catkin-like, slender-stalked and clustered at the end of short spurs: cone short-stalked, pendent, with ovate-lanceolate deciduous scales and with bracts about half as long as the scales; each scale with 2 seeds with the wings nearly as long as the scale; cotyledons 5–6. (Name derived from Greek *pseudos*, false, and *larix*; the tree being similar to, but not a true larch.)—The only species is known wild only from a restricted region in eastern China, where it grows in the mountains at an altitude of about 3,000–4,000 feet. It is closely allied to Larix, but differs in the stalked, pendulous, clustered, staminate flowers and in the deciduous cone-scales, which separate from the axis at maturity, as in the fir.

P. amabilis, Rehd. (*P. Kaempferi*, Gord. *P. Fortunei*, Mayr. *Pinus Kaempferi*, Parl., not Lamb. *Larix Kaempferi*, Fort., not Sarg. *Laricopsis Kaempferi*, Kent). Fig. 77 and Plate XXXIX. Tree attaining 130 feet in height; bark reddish-brown, fissured into small narrow scales: leaves linear, acuminate, soft, light green, bluish-green beneath, 1½–3 inches long and 1–1½ lines broad: staminate flowers yellow, about ¼ inch long, slender-stalked; fertile flowers about ¾ inch long: cone ovate, reddish-brown,

2½–3 inches long, 1⅔–2 inches broad; scales triangular, ovate-lanceolate, cordate at the base, emarginate at the apex, woody; bracts ovate-lanceolate, much smaller than the scales; seeds about ⅓ inch long. Eastern China.—Introduced to England in 1854 and from there to America in 1859. Hardy as far north as Massachusetts. A handsome tree of broad-pyramidal habit clothed with light green feathery foliage turning to golden-yellow in autumn. It is not doing well on limestone soil.

77. Pseudolarix amabilis.

26. LARIX, Mill. LARCH

Deciduous resinous trees with irregularly whorled spreading branches and thick furrowed and scaly bark: leaves linear, in crowded clusters on short spurs except on the leading shoots where they are spirally arranged: flowers monœcious; staminate flowers small, globose to oblong, solitary, consisting of numerous short-stalked, spirally arranged anthers; fertile flowers larger, consisting of several or numerous scales, each scale with 2 ovules at the base and borne in the axil of a much longer bract: cone with woody, 2-seeded scales, persistent on the axis; seeds with large, thin wings, ripening the first year; cotyledons 6–8, usually 6. (Larix is the ancient Latin name of the larch-tree.)—About 10 species in the colder regions and on the high mountains of the northern hemisphere.

A. Leaves keeled on both sides: bracts of the cones exceeding the scales.....1. *L. Potanini*
AA. Leaves flat or rounded above.
B. Bracts exceeding the scales.....2. *L. occidentalis*
BB. Bracts shorter than the scales.
C. Under surface of leaves with 2 white bands: cone-scales reflexed at apex.....3. *L. Kaempferi*
CC. Under surface of leaves without conspicuous white bands, shape very narrow: cone-scales not reflexed at apex.
D. Cone-scales pubescent or puberulous on back, 40–50 in each cone: branchlets usually glabrous.
E. Scales of cone not incurved at apex, straight; bracts about half as long as scale: leaves up to 1½ inches long.....4. *L. decidua*

EE. Scales of cone slightly incurved at apex, longitudinally convex; bracts about ⅓ as long as scale: leaves up to 2 inches long.....5. *L. sibirica*

DD. Cone-scales glabrous, striate, lustrous.

E. Branchlets usually pubescent: leaves exceeding 1¼ inches in length: cone with 20–40 scales.....6. *L. dahurica*

EE. Branchlets glabrous, brown: leaves 1¼ inches long or less: cone with 12–15 scales.....7. *L. laricina*

1. **L. Potanini,** Batal. (*L. chinensis*, Beiss. *L. thibetica*, Franch.). CHINA L. Tree to 100 feet tall, with rather short horizontal branches and gray or grayish-brown bark; branchlets pendulous, glabrous, lustrous, orange-brown to reddish-brown, the winter-buds of the same color but darker: leaves linear, slender, acute, ¾–1¼ inches long, grayish-green, with bands of stomata on both sides each consisting of 1 or 2 rows: cones ovoid-oblong, 1¼–1¾ inches long, at maturity violet-purple changing to grayish-brown; scales suborbicular, with rounded, entire, slightly incurved margin; bracts long-acuminate, exceeding the scales, upright, purple. Western China.—Introduced by E. H. Wilson to Great Britain in 1904 and in 1908 to the Arnold Arboretum where it has proved hardy, but is not thriving.

A closely related species is **L. Mastersiana,** Rehd. & Wils. Tree to 60 feet tall; branchlets pale yellowish-brown, slightly pubescent when young: leaves compressed: cone brown, with long-acuminate purple bracts exceeding the scales and reflexed. Western China.—Introduced in 1908 by E. H. Wilson to the Arnold Arboretum, but the young plant did not do well.

Another related species is **L. Lyallii,** Parl. LYALL L. Tree to 80 feet tall, with remote long branches; branchlets stout, brown-tomentose: leaves 4-angled, rigid, acute, 1–1½ inches long: cones 1½–2 inches long, with pubescent scales spreading at maturity and finally reflexed; bracts long-acuminate, exserted, upright. High mountains of British Columbia and Alberta to Washington and Montana.—Introduced several times into cultivation but it never succeeded.

2. **L. occidentalis,** Nutt. WESTERN L. Tall tree to 150 feet high, with dark-colored bark, becoming bright cinnamon-red on older trunks, and with short horizontal branches, forming a narrow pyramidal head; branchlets orange-brown, pubescent when young, soon glabrous; winter-buds dark chestnut-brown: leaves rigid, sharply pointed, triangular, keeled beneath, 1–1¾ inches long, pale green: cone oblong, 1–1½ inches long; scales orbicular, almost entire, tomentose beneath. British Columbia to Montana and Oregon.—Introduced in 1881 through the Arnold Arboretum to the eastern States and Europe. Hardy as far north as Massachusetts and perhaps farther north.

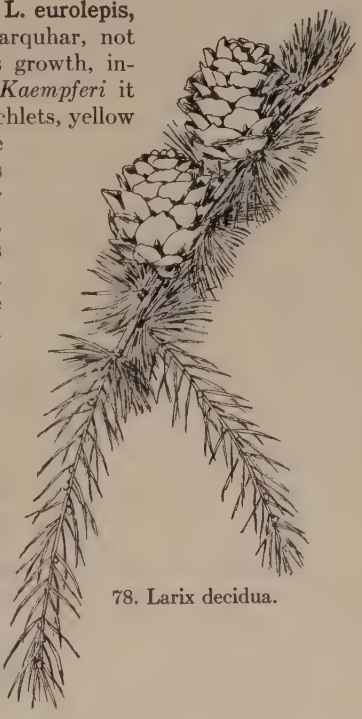
A related species is **L. Griffithiana,** Carr. (*L. Griffithii*, Hook. f. & Thoms.). Tree to 60 feet tall, with pendulous branches; branchlets dull reddish-brown;

leaves obtuse: cones oblong, 3–4 inches long; scales truncate or slightly emarginate at apex; bracts lanceolate, reflexed. Southwestern China and Himalaya.—Introduced first in 1848 and later repeatedly, but it never succeeded in cultivation.

3. **L. Kaempferi,** Sarg., not Carr. (*L. leptolepis,* Murr. *L. japonica,* Carr.). JAPANESE L. Tree to 90 feet tall, with short horizontal branches; bark gray peeling off in narrow strips leaving red scars; branchlets yellowish- or reddish-brown, glabrous, usually bloomy the first year; spurs short and globular: leaves rather broad, obtuse, soft, ½–1½ inches long, light or bluish-green: cones ovoid-oblong, ½–1½ inches long, with emarginate roundish ovate scales. Japan.—Introduced in 1861 by J. G. Veitch to Great Britain. Hardy as far north as Massachusetts and one of the handsomest and most rapidly growing larches. The dwarf form of the high mountains of Japan, var. **minor,** Sarg. (*L. leptolepis* var. *minor,* Murr.), reverts under cultivation to the normal form.

A hybrid of this species and *L. decidua* is **L. eurolepis,** Henry (*L. Henryana,* Rehd. *L. hybrida,* Farquhar, not Schroed.). DUNKELD L. Tree of vigorous growth, intermediate between the parents. From *L. Kaempferi* it differs chiefly in the less bloomy young branchlets, yellow or grayish-yellow the second year, in the shorter and narrower leaves with fewer rows of stomata; from *L. decidua* in the slightly bloomy branchlets and in the larger leaves, those of the shoots with the stomatic bands above composed of 2–4 and the bands beneath composed of 5–7 rows of stomata, those of the spurs with 1 or 2 rows on each side above and with 3–5 rows on each side beneath. It originated about 1900 at Dunkeld, Scotland, and was introduced to the Arnold Arboretum in 1910.

4. **L. decidua,** Mill. (*L. europæa,* DC. *L. Larix,* Karst.). EUROPEAN L. Fig. 78. Tree to 100 feet tall, with pyramidal, later often irregular, head; bark dark grayish-brown; branchlets slender, glabrous, yellowish: leaves compressed, triangular, soft and obtuse, bright green, ¾–1½ inches long: fertile flowers purplish: cones ¾–1½ inches long, with 40–50 almost orbicular scales, usually puberulous or glabrous on the back, loosely appressed at



78. Larix decidua.

maturity; seed-wings extending to the upper margin of the scale. Mountains of northern and central Europe.—Hardy as far north as southern Ontario and New England.

Var. **pendula,** Kuntze (var. *pendulina,* Regel. *L. europæa* var. *pendula,* Laws.). WEEPING EUROPEAN L. A form with pendulous branches.

5. **L. sibirica,** Ledeb. (*L. europæa* var. *sibirica,* Regel, and var. *rossica,* Regel). SIBERIAN L. Tree to 120 feet, with straight slender stem and rather short ascending branches; branchlets yellow; winter-buds grayish-brown and dark brown or nearly black at the base: leaves linear, 1–2 inches long: fertile flowers usually green, sometimes whitish or brownish: cones ovate-oblong, usually 1½ inches long; scales about 30, larger than in the preceding species, finely tomentose on the back, truncate or rounded at the margin, half-spreading at maturity; seed-wings not extending to the upper margin of the scales. Northeastern Russia to Siberia.—Introduced in 1806 to England. Hardy as far north as Saskatchewan.

6. **L. dahurica,** Turcz. (*L. Cajanderi,* Mayr). DAHURIAN L. Tree to 70 feet, of fairly regular habit while young, old trees usually irregular with wide-spreading branches; branchlets bloomy; winter-buds yellowish-brown, darker or nearly black at the base: leaves bright green, linear, about 1½ inches long: cones small, ¾–1 inch long; scales orbicular or ovate, rounded or emarginate at the apex, lustrous, about 20 or more. Northeastern Asia.—Introduced to Great Britain in 1827. Hardy probably as far north as Saskatchewan, but rare in cultivation and scarcely of value as an ornamental tree.

Var. **japonica,** Regel (*L. kamtchatica,* Carr. *L. kurilensis,* Mayr.). KURILE L. Young branchlets reddish and often bloomy, pubescent. Saghalin, Kurile Islands.—Introduced in 1888 to Europe by Dr. H. Mayr and in 1894 to the Arnold Arboretum where it has proved perfectly hardy and is growing well.

Var. **Principis Rupprechtii,** Rehd. & Wils. (*L. Principis Rupprechtii,* Mayr). Cones larger, to 1½ inches long; scales 30–40, truncate at the apex; bracts at least on the lower part of the cone more than half as long as the scales. Northern China.—Introduced to Europe by Dr. H. Mayr in 1903 and to the Arnold Arboretum in 1909 by Wm. Purdom. It is perfectly hardy in Massachusetts and is growing well.

7. **L. laricina,** K. Koch (*L. americana,* Michx. *L. microcarpa,* Desf.). AMERICAN L. (TAMARACK. HACKMATACK). Tree to 60 feet tall, with horizontal branches, forming a narrow pyramidal head, sometimes broad and open on older trees; bark reddish-brown; branchlets slender, glabrous, reddish-yellow, often bloomy; winter-buds reddish-brown: leaves linear, obtuse, 1–1½ inches long, of light bluish-green color: cones small, oval or almost globular, ½–¾ inch long; scales 12–15, almost orbicular and entire,

glabrous. From Labrador to Alaska, south to Pennsylvania, Indiana, Minnesota, and British Columbia.—Introduced to Europe before 1737. Hardy as far north as Saskatchewan.

A supposed hybrid between this species and *L. decidua* is **L. pendula,** Salisb. (*L. americana* var. *pendula*, Loud.). Differing from *L. laricina* chiefly in its larger cones, with 20–30 scales pubescent below the middle; from *L. decidua* in its smaller cones with the scales glabrous above the middle and in its shorter bracts. Originated in England before 1800.

27. CEDRUS, Loud. CEDAR

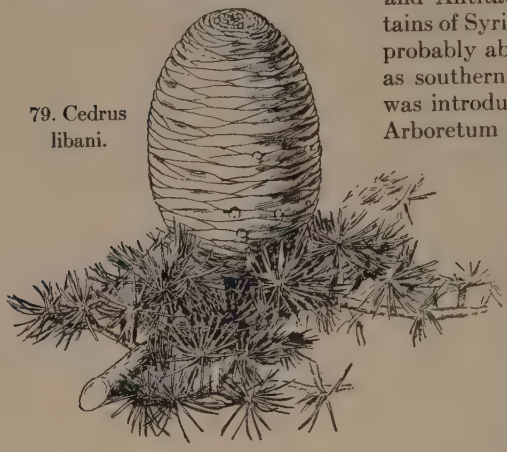
Large evergreen trees with horizontally spreading, irregularly disposed branches; bark dark gray, smooth on young stems, thick and fissured on old trees: leaves alternate on leading shoots or fascicled on spurs, quadrangular, stiff: flowers monœcious; the staminate ones terminal on spurs, cylindric, upright, about 2 inches long; female flowers ovoid, purplish, about ½ inch long, consisting of numerous suborbicular 2-ovuled scales subtended by small bracts: cones ovoid to ovoid-oblong, 3–5 inches long, with broad closely imbricate scales, attaining maturity the second or third year; seeds angular, with large membranous wings; cotyledons 8–10. (Name derived from *kedros*, used by the ancient Greek for resinous trees, chiefly Juniper.)—Three closely related species in North Africa, Cyprus, Asia Minor, and on the Himalayas; sometimes considered races of one species.

A. Leading shoot stout, upright or nodding; branchlets only exceptionally pendulous: cones truncate and often concave at apex.
  B. Branchlets densely short-pubescent: leaves as high or higher than broad, usually less than 1 inch long ..... 1. *C. atlantica*
  BB. Branchlets glabrous or slightly pubescent: leaves broader than high, usually 1–1¼ inches long ..... 2. *C. libani*
AA. Leading shoot and branchlets pendulous, densely pubescent: leaves to 2 inches long: cones rounded at apex ..... 3. *C. Deodara*

1. C. atlantica, Manetti (*C. libani* var. *atlantica*, Hook. f.). Atlas C. Large pyramidal tree to 120 feet tall, with upright leading shoots: leaves mostly less than 1 inch long, usually higher than broad, rigid, pale or bluish-green: cones 2–3 inches long, light brown; scales about 1½ inches wide. Atlas Mountains of Algeria.—Introduced some time before 1840. Hardy as far north as New York.

Var. **glauca,** Carr. Blue Atlas C. Foliage glaucous, with silvery hue; a very desirable and vigorous form. This form is hardier than the type and will survive in sheltered positions as far north as Massachusetts. Var. **argentea,** Murr. Silver Atlas C., with more decidedly silvery-white foliage, is scarcely different.

2. **C. libani,** Loud. (*C. Cedrus,* Huth. *C. patula,* K. Koch. *C. effusa,* Voss). CEDAR OF LEBANON. Fig. 79 and Plate XL. Large tree, with wide-spreading horizontal branches, forming a broad head when older, leading shoot nodding: leaves 1 inch or longer, broader than thick, dark or bright green, sometimes bluish or silvery: cones 3–4 inches long, brown. Asia Minor, on the Taurus and Antitaurus and the Lebanon Mountains of Syria.—Introduced to Great Britain probably about 1638. Hardy as far north as southern New York, but a hardier race was introduced in 1904 through the Arnold Arboretum from high altitudes of the Cilician Taurus. This race has proved hardy at the Arnold Arboretum, only in unusually severe winters the trees have been slightly injured, but they have always fully recovered the following summer. The cedar of Lebanon usually grows well under cultivation and thrives in any fairly good soil. It is a beautiful tree of distinct and characteristic appearance which even in cultivation attains considerable dimensions, as many stately old trees in European gardens bear witness. Aside from its ornamental value it is of peculiar interest for its scriptural and historical associations and is well worth planting wherever it will thrive.



79. Cedrus libani.

Var. **glauca,** Carr. (var. *argentea,* Veitch). Foliage of blue or nearly silvery-white hue.

A geographical variety is var. **brevifolia,** Hook. f. (*C. brevifolia,* Henry), from Cyprus, with shorter leaves and smaller cones.—Introduced to Great Britain in 1881, but has proved tenderer than the type.

3. **C. Deodara,** Loud. (*C. libani* var. *Deodara,* Hook. f.). DEODAR C. Plate XLI. Tall tree, of pyramidal habit, to 150 feet: leaves 1–2 inches long, dark bluish-green, rigid, as thick as broad: cones 3½–5 inches long, reddish-brown; scales 2–2⅓ inches wide. Northwest Himalaya from Kumaon to Afghanistan.—Introduced to Great Britain in 1831. Hardy as far north as the Middle Atlantic States. A very handsome tree of more regular pyramidal outline than the two preceding species and more graceful on account of the pendulous branchlets.

Var. **viridis,** Carr., GREEN DEODAR C., is a form with the foliage of deeper green.

Var. **argentea**, Nels. Foliage silvery-white.

Var. **aurea**, Nels. Golden Deodar C. Foliage yellow.

Var. **robusta**, Carr. Longleaf Deodar C. With stouter branches and more rigid leaves about 2 inches long.

28. PINUS, L. PINE

Evergreen trees with usually whorled branches, rarely shrubby; winter-buds covered with imbricate scales: leaves of 2 kinds; the primary leaves are spirally arranged and as they appear on young seedling plants and occasionally on shoots from the old wood, are green and subulate, but commonly they are reduced to small scarious bracts bearing in their axils the acicular, semiterete or triangular secondary leaves borne on an undeveloped branchlet in clusters from 2–5, or occasionally more, rarely reduced to 1, surrounded at the base by a sheath of 8–12 bud-scales: flowers monœcious; the staminate ones axillary, clustered at the base of the young shoots, catkin-like, yellow, orange, or scarlet, composed of numerous spirally arranged 2-celled anthers with the connective enlarged and scale-like at the apex; the fertile flowers lateral or subterminal, greenish or purplish, consisting of numerous spirally arranged scales each in the axil of a small bract and bearing 2 ovules inside near the base: cone subglobose to cylindric, with woody scales closely appressed before maturity and tightly inclosing the seeds, which are usually furnished with a long thin wing, but in some species are wingless or short-winged; the apex of the scales is usually more or less thickened and the exposed part, which is usually rhombic in outline and termed apophysis, is often protracted into prominent bosses or knobs; the apophysis is terminated by the umbo, usually differing in color and ending mostly in a spine or prickle. In *P. Strobus* and the allied species the apophysis is flat and thin, and bears the spineless umbo at the upper end, while in most other pines the apophysis is thickened and transversally keeled and bears the umbo in the middle. These differences belong to the most important characters in the grouping of the species: other valuable characters are furnished by the structure of the leaves, which contain either one or two fibro-vascular bundles and usually two or more resin-ducts, which are either marginal (external or peripheral), i. e., situated beneath the epidermis, or medial (parenchymatous), i. e., inclosed by the tissue of the leaf; or internal, i. e., close to the fibro-vascular bundles; some species, as *P. Armandi*, *P. resinosa*, *P. sinensis*, also *P. excelsa*, *P. Lambertiana*, *P. virginiana*, have resin-ducts in 2 positions, either marginal and medial or internal and medial, but such combinations are not found in all the leaves of these species. Strengthening cells, i.e., cells with thickened walls, are mostly present beneath the epidermis and often surround the resin-ducts, sometimes also along the fibro-vascular bundles.

The number of the fibro-vascular bundles and the position of the resin-ducts can be readily seen with a common magnifying glass in thin cross-sections made with a sharp razor from the middle of the leaf and placed on a glass plate. The shoot which develops in spring from the terminal winter-bud (spring-shoot) produces in most species only one internode with one whorl of branchlets and is therefore called uninodal and bears the cones at the end of the shoot (subterminal), while in other species the spring-shoot produces two or more often incomplete whorls of branchlets (multinodal shoots) and bears the cones partly in the middle of the shoot (lateral); occasionally summer-shoots appear on uninodal shoots and change it thus to an incompletely multinodal branchlet. (Pinus is the old Latin name of the pine-tree.)—The genus contains about 70 species distributed throughout the northern hemisphere from the arctic circle to Mexico and the West Indies, North Africa, and the Malayan Archipelago; in the tropical and subtropical regions they are confined to the mountains.

Pinus is the largest and at the same time the most important of all the coniferous genera. In the colder and temperate regions it furnishes not only the most important timber trees, but also the most valuable evergreen plant material for permanent and larger plantations, as the more valuable pines, unlike most spruces and firs, do not lose their beauty with age, but gain in character and picturesque appearance.

KEY TO THE SPECIES BASED CHIEFLY ON CONE-CHARACTERS

A. Bracts subtending the leaf-fascicle not decurrent; sheath of fascicle deciduous; leaf with one fibro-vascular bundle (HAPLOXYLON).
  B. Scales with terminal umbo.
    C. Seeds wingless or with rudimentary wing.
      D. Margin of leaves serrulate.
        E. Branchlets pubescent or tomentose: cones indehiscent.
          F. Cones cylindric-conical: branchlets pubescent.... 1. *P. koraiensis*
          FF. Cones ovoid: branchlets brownish-tomentose..... 2. *P. Cembra*
        EE. Branchlets glabrous: cones dehiscent, cylindric-conical..... 5. *P. Armandi*
      DD. Margin of leaves entire.
        E. Cones indehiscent..... 3. *P. albicaulis*
        EE. Cones dehiscent..... 4. *P. flexilis*
    CC. Seeds winged, with long wing (rather short in No. 8).
      D. Length of cones 10–18 inches: branchlets pubescent.
        E. Cone-scales with elongated and recurved apex: leaves slender..... 6. *P. Ayacahuite*
        EE. Cone-scales rounded: leaves stout..... 7. *P. Lambertiana*
      DD. Length of cones less than 10 inches.
        E. Cone-scales with convex thickening.
          F. Cone about 2 inches long, ovoid: branchlets pubescent..... 8. *P. parviflora*

FF. Cone 3½–10 inches long, cylindric: branchlets glabrous.
G. Leaves 3–4 inches long, stiff..... 9. *P. Peuce*
GG. Leaves 6–8 inches long, drooping.....10. *P. excelsa*
EE. Cone-scales uniformly thin.
F. Branchlets pubescent at first: leaves stiff.....11. *P. monticola*
FF. Branchlets glabrous or slightly puberulous: leaves thin, soft.....12. *P. Strobus*
BB. Scales with dorsal umbo.
C. Seeds wingless or with very short wing: cones green at maturity.
D. Leaves entire, ¾–1½ inches long, 1–4 in a fascicle.....13. *P. cembroides*
DD. Leaves serrulate, 2–4 inches long, 3 in a fascicle.....14. *P. Bungeana*
CC. Seeds with long wing; cones purple at maturity.
D. Cones with minute incurved prickles.....15. *P. Balfouriana*
DD. Cones with long and slender prickles.....16. *P. aristata*
AA. Bracts subtending the leaf-fascicle decurrent; sheath persistent; leaves with two fibro-vascular bundles: umbo of cone-scales dorsal (DIPLOXYLON).
B. Seed-wing very short or long and adnate.
C. Wing long, adnate: leaves 8–12 inches long, in clusters of 3.
D. Apophysis elongated and recurved; seed ¾–½ inch long: stem and branches without small branchlets...17. *P. longifolia*
DD. Apophysis broad-pyramidal; seed ½ inch long: stem and branches with small branchlets.....18. *P. canariensis*
CC. Wing very short, deciduous: leaves 5–8 inches long, 2.....19. *P. Pinea*
BB. Seed-wing articulate (detachable as a whole).
C. Wing of seed membranous, long.
D. Cones deciduous, dehiscent at maturity (in No. 26 persistent and leaves sometimes 3).
E. Leaves in clusters of 2: spring-shoots uninodal and cones subterminal.
F. Bark of 2–4-year-old branchlets without sharply defined conspicuous oblong scales, peeling off irregularly: leaves with marginal resin-ducts.
G. Branchlets bloomy: leaves 2½–5 inches long...20. *P. densiflora*
GG. Branchlets not bloomy.
H. Length of leaves 4–8 inches.....21. *P. Massoniana*
HH. Length of leaves ¾–3 inches.
I. Cone short-stalked, with an obtuse gray umbo: leaves more or less bluish-green: usually a tree.....23. *P. sylvestris*
II. Cone subsessile, with prickly umbo: leaves bright green: usually a shrub.....24. *P. Mugo*
FF. Bark of 2–4-year-old branchlets covered with conspicuous sharply defined scales (the decurrent base of the bract), each peeling off as a whole: leaves 2½–7 inches long.
G. Branchlets grayish-white.....25. *P. leucodermis*
GG. Branchlets grayish-yellow or orange to brown.
H. Resin-ducts of leaves medial or medial and marginal.

I. Winter-buds brown.
J. Cones deciduous: winter-buds resinous: leaves 2, their sheath about ⅗ inch long....26. *P. nigra*
JJ. Cones tenaciously persistent: winter-buds not resinous: leaves sometimes 3, sheath up to 1 inch long....28. *P. sinensis*
II. Winter-buds grayish-white, cylindric, not resinous....27. *P. Thunbergii*
HH. Resin-ducts marginal: leaves light green: branchlets orange....22. *P. resinosa*
EE. Leaves in clusters of 3, or 2 and 3 (2 in No. 32 and shoots multinodal): spring-shoots often multinodal.
F. Resin-ducts of leaves medial.
G. Young cones subterminal: shoots uninodal.
H. Branchlets orange: cones 3–6 inches long....29. *P. ponderosa*
HH. Branchlets glaucous: cones 5–15 inches long.30. *P. Jeffreyi*
GG. Young cones lateral: shoots multinodal.
H. Length of leaves 3–5 inches.
I. Bark of branches and trunk rough: leaves 2 or 3 in a cluster....31. *P. echinata*
II. Bark of branches and of upper part of trunk smooth: leaves always 2....32. *P. glabra*
HH. Length of leaves 6–9 inches....33. *P. Tæda*
FF. Resin-ducts internal, leaves 8–18 inches long.
G. Winter-buds whitish: cone dull brown, 6–10 inches long: spring-shoots usually uninodal..34. *P. palustris*
GG. Winter-buds light brown: cone lustrous brown, 3–6½ inches long: spring-shoots multinodal .35. *P. caribæa*
DD. Cones tenaciously persistent, often serotinous (opening one or several years after maturity): leaves with medial resin-ducts (marginal in No. 36): spring-shoot multinodal and cones lateral (in Nos. 36 and 37 sometimes uninodal).
E. Leaves in clusters of 2.
F. Resin-ducts of leaves marginal: cone with obtuse umbo....36. *P. halepensis*
FF. Resin-ducts medial.
G. Strobiles (cones) symmetrical.
H. Length of leaves 5–8 inches....37. *P. Pinaster*
HH. Length of leaves 1–3½ inches.
I. Prickles of cone stout....38. *P. pungens*
II. Prickles of cone slender.
J. Cones remaining closed for many years .39. *P. clausa*
JJ. Cones opening at maturity....40. *P. virginiana*
GG. Strobiles (cones) unsymmetrical.
H. Length of leaves less than 4 inches.
I. Cone not prickly, curved....41. *P. Banksiana*
II. Cone prickly, straight and sometimes symmetrical....42. *P. contorta*
HH. Length of leaves 4–6 inches: cone with stout and large prickles....43. *P. muricata*

EE. Leaves in clusters of 3: cone prickly.
F. Cone symmetrical.....44. *P. rigida*
FF. Cone unsymmetrical.
G. Prickles of cone minute: upper part of trunk rough.....45. *P. radiata*
GG. Prickles of cone stout: upper part of trunk smooth.....46. *P. attenuata*
CC. Wing of seed thick: leaves 3–5, 6–13 inches long: cones large.
D. Leaves in clusters of 3, 6–12 inches long.
E. Cone conic-oblong; wing of seeds about 1 inch long: leaves stout.....47. *P. Coulteri*
EE. Cone broad-ovoid; wing about half as long as seed: leaves slender.....48. *P. Sabiniana*
DD. Leaves in clusters of 5, rigid, 8–13 inches long: cone broad-ovoid; seed short-winged.....49. *P. Torreyana*

KEY FOR THE DETERMINATION OF PINES WITHOUT CONES

A. Bracts subtending the leaf-clusters not decurrent; sheaths of leaf-clusters deciduous, sometimes tardily so.
B. Leaves in clusters of 5, only occasionally 3 or 4.
C. Margin of leaves serrulate.
D. Young branchlets glabrous or minutely puberulous at first.
E. Length of leaves 6–8 inches, slender and pendulous: young branchlets glaucous.....10. *P. excelsa*
EE. Length of leaves 3–5 inches: branchlets not glaucous.
F. Branchlets glabrous even when young.
G. Winter-buds ovoid: leaves more or less appressed to the branch, with marginal resin-ducts.....9. *P. Peuce*
GG. Winter-buds cylindric, chestnut-brown: leaves spreading; resin-ducts marginal or medial. 5. *P. Armandi*
FF. Branchlets puberulous at first, soon glabrous: spreading.....12. *P. Strobus*
DD. Young branchlets tomentose or pubescent (sometimes nearly glabrous in No. 6).
E. Stomata lacking on back of leaves.
F. Branchlets pubescent (sometimes nearly glabrous in No. 6).
G. Length of leaves 4–6 inches, slender.....6. *P. Ayacahuite*
GG. Length of leaves shorter.
H. Bark of trunk fissured: leaves 2–4 inches long. 11. *P. monticola*
HH. Bark of trunk smooth: leaves ¾–2, rarely 3 inches long, usually twisted and forming brush-tufts at end of branchlets.....8. *P. parviflora*
FF. Branchlets tomentose.
G. Habit loose, with spreading branches: leaves 3–6 inches long.....1. *P. koraiensis*
GG. Habit compact; branches ascending: leaves 2–4 inches long.....2. *P. Cembra*

EE. Stomata on back of leaves: leaves 3–4 inches long: branchlets pubescent ..... 7. *P. Lambertiana*

CC. Margin of leaves entire (remotely serrulate in a var. of No. 4).

D. Sheaths deciduous the first year: leaves 1½–3 inches long, with stomatic lines on back.

E. Young shoots glabrous or puberulous: leaves stout .. 3. *P. albicaulis*

EE. Young shoots puberulous: leaves slender, not more than ¼ inch thick ..... 4. *P. flexilis*

DD. Sheaths deciduous during the second or third year: leaves 1–1⅗ inches long, without stomata on back.

E. Branchlets dark orange-brown, puberulous at first: leaves without resinous exudations ..... 15. *P. Balfouriana*

EE. Branchlets light orange, glabrous or nearly so: leaves sprinkled with resinous exudations ..... 16. *P. aristata*

BB. Leaves 1–4, only occasionally 5: branchlets glabrous.

C. Margin of leaves serrulate; leaves 3: bark of trunk exfoliating in large thin plates ..... 14. *P. Bungeana*

CC. Margin of leaves entire: leaves 1–4: bark fissured ..... 13. *P. cembroides*

AA. Bracts subtending the leaf-clusters decurrent; sheaths of leaf-clusters persistent.

B. Number of leaves 3–5, only occasionally 2.

C. Leaves 5, 8–12 inches long (see also var. of No. 29) ..... 49. *P. Torreyana*

CC. Leaves 3.

D. Leaf slender, drooping, 8–18 inches long.

E. Branchlets not bloomy.

F. Winter-buds white, with conspicuously fringed scales: leaves 8–18 inches long, with internal resin-ducts ..... 34. *P. palustris*

FF. Winter-buds brown: leaves 8–12 inches long, with marginal resin-ducts ..... 17. *P. longifolia*

EE. Branchlets bloomy.

F. Winter-buds with conspicuously long-fimbriate recurved scales, not resinous: leaves with marginal resin-ducts: spring-shoots uninodal ..... 18. *P. canariensis*

FF. Winter-buds not conspicuously fringed, resinous: leaves with medial resin-ducts: spring-shoots multinodal ..... 48. *P. Sabiniana*

DD. Leaf stiff and straight.

E. Branchlets glaucous: leaves bluish- or grayish-green.

F. Winter-buds not or slightly resinous: leaves 4–8 inches long.

G. Bloom on branchlets slight: leaves often 2, dark or bluish-green.

H. Bark of older branchlets peeling off in well-defined plates: leaves 4–7 inches long, with marginal or with marginal and medial resin-ducts ..... 28. *P. sinensis*

HH. Bark of older branchlets peeling off in irregular scales: leaves 3–5 inches long, with medial or with medial and internal resin-ducts ..... 31. *P. echinata*

GG. Bloom of branchlets copious: leaves 5–8 inches long, pale bluish-green, rarely 2.....30. *P. Jeffreyi*
FF. Winter-buds resinous: leaves 6–12 inches long....47. *P. Coulteri*
EE. Branchlets not glaucous (sometimes slightly so in No. 33).
F. Length of leaves 6–12 inches.
G. Resin-ducts internal; leaves in clusters of 2 and 3.....35. *P. caribæa*
GG. Resin-ducts medial; leaves in clusters of 3.
H. Color of leaves light bluish-green.....33. *P. Tæda*
HH. Color of leaves dark yellow-green.....44. *P. rigida* var.
FF. Length of leaves 3–7 inches.
G. All leaves slender, about $\frac{1}{24}$–$\frac{1}{18}$ inch thick: bud-scales with appressed tips.
H. Bark on trunk and branches rough: leaves grass-green, soft.....45. *P. radiata*
HH. Bark on upper part of trunk and on branches smooth: leaves yellow or bluish-green, firm.....46. *P. attenuata*
GG. All leaves stout.
H. Winter-buds ovoid, acute or acuminate, with appressed scales: leaves rounded on back.29. *P. ponderosa* var
HH. Winter-buds oblong-ovoid, with spreading scales: leaves flat on back.....44. *P. rigida*
BB. Number of leaves 2.
C. Spring-shoots uninodal, with only one whorl of branchlets.
D. Bark of 2–4-year-old branchlets divided into conspicuous and sharply defined plates (the decurrent base of the bracts), each peeling off as a whole.
E. Branchlets grayish-white: winter-buds not resinous, ovoid-oblong.....25. *P. leucodermis*
EE. Branchlets orange to brown or grayish-yellow.
F. Winter-buds brown.
G. Young branchlets not bloomy: winter-buds resinous.
H. Leaves with medial resin-ducts, their sheath about $\frac{3}{5}$ inch long.....26. *P. nigra*
HH. Leaves with marginal resin-ducts, their sheath about $\frac{4}{5}$ inch long.....22. *P. resinosa*
GG. Young branchlets bloomy: winter-buds not resinous: leaves sometimes 3.....28. *P. sinensis*
FF. Winter-buds grayish-white, cylindric-oblong, with conspicuously fimbriate scales.....27. *P. Thunbergii*
DD. Bark of 2–4-year-old branchlets not conspicuously divided into plates, peeling off irregularly.
E. Length of leaves 1–3½ inches.
F. Leaves bluish-green or grayish-green: usually a tree.....23. *P. sylvestris*
FF. Leaves bright green: usually shrub.....24. *P. Mugo*
EE. Length of leaves 3–9 inches.
F. Young branchlets bloomy: leaves slender, bright green.....20. *P. densiflora*

FF. Young branchlets not bloomy (sometimes slightly so in Nos. 36 and 37).
G. Leaf with marginal resin-ducts.
H. Leaves 5–8 inches long.
I. All leaves stiff and rigid.....19. *P. Pinea*
II. All leaves very thin and slender.....21. *P. Massoniana*
HH. Leaves 3–6 inches long.....36. *P. halepensis*
GG. Leaf with medial or internal resin-ducts, lustrous green, 5–9 inches long.....37. *P. Pinaster*
CC. Spring-shoots multinodal, with more than one whorl of branchlets.
D. Young branchlets glaucous.
E. Winter-buds not or little resinous: leaves 3–5 inches long, sometimes 3.....31. *P. echinata*
EE. Winter-buds resinous, with appressed scales: leaves 1½–3 inches long.....40. *P. virginiana*
DD. Young branchlets not glaucous (sometimes slightly so in No. 36).
E. Length of leaves ½–3½ inches.
F. Branchlets brown to orange: leaves with medial resin-ducts.
G. All leaves slender: branchlets brown.....39. *P. clausa*
GG. All leaves stout: branchlets orange to orange-brown.
H. Leaves ¾–1½ inches long, twisted and flattened, in remote clusters.....41. *P. Banksiana*
HH. Leaves 1–3½ inches long.
I. Leaf slightly twisted, with 2–5 resin-ducts. 38. *P. pungens*
II. Leaf strongly twisted, with 1 or 2 resin-ducts.....42. *P. contorta*
FF. Branchlets dull greenish-yellow, sometimes bloomy: leaves often longer than 3½ inches, with marginal resin-ducts.....36. *P. halepensis*
EE. Length of leaves 3–9 inches.
F. Resin-ducts marginal: leaves 3–6 inches long.....36. *P. halepensis*
FF. Resin-ducts medial or internal.
G. Leaves 5–9 inches long, lustrous green: winter-buds not resinous.....37. *P. Pinaster*
GG. Leaves 4–6 inches long, dark green.
H. Winter-buds not or little resinous: bark of branches and upper part of trunk smooth .32. *P. glabra*
HH. Winter-buds resinous: bark of branches and trunk scaly.....43. *P. muricata*

Subgenus I. HAPLOXYLON. SOFT PINES.

Leaves with one fibro-vascular bundle, entire or serrulate; base of bract subtending the leaf-fascicle not decurrent; sheath of leaf-cluster deciduous (except in the Mexican *P. Nelsonii*, Shaw): wood soft, with little resin, light-colored.

Section I. Cembra

Umbo of cone-scales terminal; scales of the young cone unarmed: leaves in fascicles of 5, with deciduous sheaths.

Group 1. Cembræ

Seeds wingless; cone indehiscent, deciduous at maturity.

1. **P. koraiensis,** Sieb. & Zucc. (*P. mandshurica*, Rupr.). Korean P. Pyramidal tree to 100 feet tall; bark gray or gray-brown, thin, peeling off in irregular flakes, red-brown beneath; branchlets with yellowish-brown pubescence; winter-buds oblong-ovate, acuminate, dark chestnut-brown: leaves straight, dark green and glossy on the back, bluish-white on the inner sides, 2½–4 inches long: cones short-peduncled, conic-oblong, yellowish-brown, 4–6 inches long; scales rhombic-obovate, with recurved obtuse apex; seed over ½ inch long, brown, sharply edged. Japan, Korea.—Introduced 1861 to Great Britain and some years later to this country. Hardy as far north as southern Ontario and New England. A handsome tree of pyramidal habit and rather slow growth; one of the best hardy pines for smaller gardens.

2. **P. Cembra,** L. Swiss Stone P. Tree to 70 or sometimes 120 feet tall, with spreading usually short branches forming a narrow dense pyramid, in old age often with very picturesque, broad, open, round-topped head; bark greenish-gray and smooth on young trees, on old trunks reddish-gray and divided into thin scaly plates; branchlets coated with dense yellowish-brown tomentum; winter-buds globose-ovoid, long-acuminate: leaves straight, dark green on back, bluish-white inside, 2–5 inches long, with medial resin-ducts: cones short-peduncled, ovate, obtuse, light brown, 2½–3½ inches long; scales broadly ovate, rounded at apex, apophysis much broader than high; seed ½ inch long. Alps of central Europe and from northeastern Russia to Mongolia.—Hardy as far north as Saskatchewan. Handsome hardy pine of symmetrical dense habit when young and of slow growth. The large seeds are edible.

Var. **columnaris,** Beiss. A form of narrow columnar habit.

Var. **sibirica,** Loud. (*P. sibirica*, Mayr). Siberian Stone P. A form with shorter leaves and larger cones; of narrower habit and more vigorous growth.

A closely related species is **P. pumila,** Regel (*P. Cembra* var. *pumila*, Pall.). Dwarf Stone P. Shrub to 10 feet high, with the main branches usually prostrate: leaves 1¾–3 inches long, obscurely serrulate, with the resin-ducts usually marginal: cone ovoid, 1¼–1¾ inches long. Northeastern Siberia and high mountains of Korea and Japan.—Introduced to Europe before 1817, to the Arnold Arboretum in 1915 by E. H. Wilson. It is probably as hardy as the preceding species, but does not seem to do well under cultivation.

3. **P. albicaulis,** Engelm. Whitebark P. Tree to 30 or rarely to 60 feet

high or sometimes shrubby, with wide-spreading branches; bark fissured into thin brown to creamy-white scales; branchlets glabrous or puberulous with scattered, minute, short hairs, brown to orange, tough and pliable: leaves rigid, entire, 1½–2½ inches long, dark green, with stomatic lines on the back, persistent for five to eight years: cone subsessile, ovoid or globose-ovoid, 2–3 inches long, dull purple, finally brown; scales much thickened, often with stout pointed umbo; seeds ⅓–½ inch long. High mountains of British Columbia to California and Wyoming.—Introduced by Jeffrey to Great Britain in 1852. Probably hardy as far north as Canada, but difficult in cultivation; it will perhaps do best on rocky slopes of northern exposure.

80. Pinus flexilis.

Group 2. Flexiles.

Cone dehiscent; seed wingless or nearly so.

4. **P. flexilis,** James. Limber P. Fig. 80. Tree to 50, occasionally to 80 feet tall, with stout horizontal branches forming a narrow open pyramid, in old age with low, broad, round-topped head; bark dark brown or nearly black and deeply fissured on old trunks, on young stems and on the branches thin and smooth, gray to silvery-white; branchlets glabrous or minutely brown-tomentulose; winter-buds broadly ovoid, slender-pointed: leaves rigid, acute, dark green, 1⅓–3 inches long, with stomata on the back: cones short-stalked, ovoid to cylindric-ovoid, light brown, 3–6, rarely 10 inches long; scales rounded at the apex, tipped with an obtuse dark umbo, the lower ones elongated and reflexed; seeds dark brown, mottled with black, ⅛–½ inch long, with narrow wing. Alberta to California, west to Montana and western Texas.—Introduced in 1861 to the eastern States and to Europe by Dr. Parry.

Hardy as far north as Canada. A low pine, the spreading branches densely clothed with dark green leaves. It seems best adapted for planting on rocky slopes.

Var. **reflexa,** Engelm. (*P. reflexa*, Engelm. *P. strobiformis*, Sarg., not Engelm.). Tree to 100 feet tall: leaves slender, to 4 inches long, entire or remotely serrulate: cones 5–9 inches long, on longer stalks, with often thin reflexed scales. Arizona.—Doubtful whether in cultivation and probably not hardy north.

5. **P. Armandi,** Franch. (*P. scipioniformis*, Mast. *P. Mastersiana*, Hayata). Armand P. Tree to 60 feet tall, with wide-spreading horizontal branches; bark smooth, pale gray; branchlets glabrous; winter-buds cylindric, chestnut-brown: leaves slender and thin, 3–6 inches long, serrulate, bright green, without stomata on the back: cones peduncled, oblong-conical, 4–6 or sometimes 8 inches long, yellowish-brown; scales obovate, appressed, much thickened in the middle, with large broadly rhombic apophysis and small obtuse thickened umbo often slightly recurved; seeds pale reddish-brown, ovoid, compressed, ½ inch long, with a sharp edge all around. Central and western China, Formosa.—Introduced to France in 1895 and a few years later to the Arnold Arboretum where it has proved perfectly hardy. A handsome pine of rather loose habit with wide-spreading branches.

Group 3. Strobi.

Seed with a long wing adnate to the nut.

6. **P. Ayacahuite,** Ehrenb. (*P. Bonapartea*, Roezl. *P. Don-Pedrii*, Roezl. *P. Loudoniana*, Gord.). Mexican White P. Tree to 100 feet tall, with spreading slender branches; bark rough and scaly on old trees; branchlets yellowish-brown, finely pubescent: leaves slender and somewhat pendulous, bluish-green, 4–6 inches long: cones short-stalked, cylindric-conical, gradually narrowed toward the apex, often slightly curved, brownish-yellow, 9–15 inches long; seeds about ½ inch long, gray-brown, mottled dark brown. Northern Mexico to Guatemala.—Introduced about 1840 to Great Britain by Hartweg from Guatemala and hardy only in the milder parts of Great Britain, but a plant in the Arnold Arboretum, probably a hardier northern form, has proved hardy in a sheltered position.

Var. **Veitchii,** Shaw (*P. Veitchii*, Roezl). Cones to 18 inches long; seed dark brown with a short and broad wing about ½ inch long. Central Mexico.

Var. **brachyptera,** Shaw. Seeds larger; wing very short. Northern Mexico.

7. **P. Lambertiana,** Dougl. Sugar P. Tree to 200 or 220 feet tall, with spreading somewhat pendulous branches forming a narrow open pyramid; old trees usually with flat-topped, wide-spreading, open head; bark on young

stems and branches smooth and thin, dark green, on old trunks thick and deeply divided into plate-like ridges covered with large purple-brown or cinnamon-red scales; branchlets brown, pubescent; winter-buds oblong-obovate, apiculate: leaves stout, sharply pointed, dark bluish-green, 3–4 inches long, with conspicuous white lines on the back: cones on peduncles 2–3½ inches long, cylindric, often slightly curved, light brown, lustrous, 10–20 inches long; seed about ½ inch long, dark brown or nearly black. Oregon to Lower California.—Introduced to Great Britain in 1827 by David Douglas. Hardy as far north as Massachusetts in sheltered positions, but growing slowly. A handsome tree of pyramidal habit and with dark green foliage. On the Pacific Coast it is one of the tallest trees.

8. **P. parviflora,** Sieb. & Zucc. Japanese White P. Plate XXXVIII. To 80 feet of pyramidal habit, with slender horizontal branches; bark of young trees smooth, on older trees fissured into thin flaky scales, red-brown beneath; branchlets light greenish-brown, puberulous: leaves crowded, rather stiff, usually twisted, forming brush-like tufts at the end of the branchlets, bluish-green, ¾–1½ inches long: cones ovoid or oblong-ovoid, almost sessile, reddish-brown, 2–3 inches long; seeds dark brown, hardly ½ inch long, with short wing. Japan.—Introduced to Great Britain in 1861 by J. G. Veitch and its var. *pentaphylla* in 1879 by Maries. A handsome, picturesque pine with wide-spreading branches and dark green foliage. Hardy as far north as Massachusetts.

Var. **glauca,** Beiss. A form with glaucous foliage.

Var. **pentaphylla,** Henry (*P. pentaphylla,* Mayr), is the wild form and differs in its longer leaves, larger cones, and longer seed-wing from the form originally described which is much cultivated in Japan as a grafted tree and has shorter usually twisted leaves 2–4 inches long forming brush-like tufts at the end of the branchlets and is usually a lower tree of more irregular habit, bearing numerous decorative small cones when older.

9. **P. Peuce,** Griseb. (*P. excelsa* var. *Peuce,* Beiss.). Macedonian P. Attains 50 feet in height, with ascending short branches forming a narrow dense pyramid; bark smooth on young trees, grayish-brown, ultimately fissured into small plates; branchlets greenish, glabrous, not glaucous; winter-buds ovoid: leaves straight, bluish-green, 3–4 inches long, without stomata on back: cones short-stalked, cylindric, 3½–6 inches long, with obovate scales; seed 4 lines long. Mountains of the Balkan peninsula.—Introduced in 1864 to Germany. Hardy as far north as New England and southern Ontario. Ornamental pine of dense narrow-pyramidal habit and slow growth; a desirable pine for smaller gardens.

10. **P. excelsa,** Wall. (*P. Griffithii,* McClelland. *P. nepalensis,* Chambr.). Himalayan P. Attains 150 feet in height, with spreading and slightly ascending branches forming a broad open pyramid; bark grayish-brown,

fissured into small plates; branchlets greenish, glabrous, glaucous; winter-buds cylindric-obovoid, acute, pale brown: leaves slender, flaccid, drooping, grayish- or bluish-green, 6–8 inches long: cones cylindric, on 1–2 inch long stalks, 6–10 inches long; seeds brown, 4 lines long. Himalayas, from Bhutan to Afghanistan.—Introduced in 1827 to Great Britain. Hardy in sheltered positions as far north as Massachusetts, but it occasionally suffers in a very severe winter. Handsome tree of rather loose habit, with wide-spreading branches and graceful pendulous foliage.

11. **P. monticola,** Don. Western White P. Tree to 100 or occasionally 150 feet tall, with slender, spreading, somewhat pendulous branches forming a narrow open pyramid; bark of young stems smooth and thin, light gray, on old trees deeply divided into nearly square plates covered by small purple appressed scales; branchlets puberulous, yellowish- or reddish-brown; winter-buds ovoid, acute: leaves stiff, bluish-green and glaucous, 1½–4 inches long, with few inconspicuous or no lines on the back: cones short-peduncled,

81. Pinus Strobus.

cylindric, slender, slightly curved, 5–11 inches long, yellowish-brown; scales pointed by the slightly thickened, sometimes recurved umbo; seed red-brown, mottled with black, ⅓ inch long. British Columbia to Idaho and California. —Introduced to Great Britain in 1851. Hardy as far north as Massachusetts. Very similar in its general appearance to the white pine but of narrower and denser habit.

12. **P. Strobus,** L. (*Strobus Strobus,* Small). White P. Fig. 81 and Plate IV. Attains 100, occasionally 150 feet in height, with horizontal branches in regular whorls forming a symmetrical open pyramid; in old age the head is usually broad and open and often very picturesque; bark on young stems thin and smooth, green tinged with red, on old trunks thick and deeply divided into broad connected ridges covered with small, appressed, purplish scales; branchlets greenish or light greenish-brown, glabrous or slightly puberulous; winter-buds ovoid, acuminate: leaves soft, bluish-green, 2–4 inches long (or 3½–5): cones on stalks ½–1 inch long, cylindric, slender, often curved, 2–4 inches long, with oblong-obovate scales; seed red-brown, mottled with black, 3 lines long. Newfoundland to Manitoba, south to Georgia, Illinois, and Iowa.—Introduced to France before 1553 and to England about 1705. Hardy as far north as Canada and one of the most valuable ornamental pines for the eastern States; it is of rapid growth, symmetrical when young, picturesque in old age: no tree is better adapted to break up the monotonous sky-line of plantations in northern parks. There are a number of garden forms of which the following are occasionally seen in gardens.

Var. **glauca,** Beiss. A form with light bluish-green foliage.

Var. **nana,** Knight (var. *pygmæa,* Hort.). Dwarf White P. A dwarf, compact, round bush with short leaves. A neat and handsome form.

Var. **fastigiata,** Beiss. (var. *pyramidalis,* Hort.). A form with ascending branches forming a narrow-pyramidal or nearly columnar head.

Var. **prostrata,** Mast. A dwarf procumbent form with diffuse branches trailing on the ground.

Section II. Parcembra

Cone-scales with dorsal umbo; scales of the young cone mucronate or aristate: leaves with marginal resin-ducts.

Group 4. Cembroides

Seeds wingless; cones ochre-yellow to deep red-orange: leaf-sheath gradually deciduous (persistent in the Mexican *P. Nelsonii,* Shaw.).

13. **P. cembroides,** Zucc. (*P. osteosperma,* Engelm.). Mexican Stone P. Small tree, usually not over 20 feet tall, with stout spreading branches forming

a round-topped head; bark irregularly divided by shallow fissures into numerous large, thin, red-brown scales; branchlets dark orange, pubescent at first: leaves usually 3, sometimes 2, slender, dark green, with stomata on all 3 faces, much incurved, 1–2 inches long: cone subglobose, 1–2 inches broad; apophysis pyramidal, strongly keeled, lustrous brown, with broad obtuse umbo; seeds oblong-obovate, ½–¾ inch long, dark brown, with very narrow wing. Southern Wyoming to California, western Texas and northern Mexico. —Introduced before 1830 to Germany. Like the following varieties little known in the eastern States and probably not hardy north of New York. A small, round-headed, often shrubby tree of slow growth. The following varieties are often considered distinct species, but they are connected with the type and each other by intermediate forms.

Var. **monophylla,** Voss (*P. monophylla,* Torr. & Frem. *P. Fremontiana,* Endl.). Singleleaf P. Tree occasionally to 40 or 50 feet tall; branchlets light orange, glabrous: leaves usually solitary, sometimes 2, rigid, spinescent, ¾–1½ inches long, glaucous-green: cone broadly ovoid, the apophysis depressed-pyramidal, ridged, the flattened umbo with a minute incurved tip. California to Colorado and Arizona.—Introduced in 1848 to Europe. Hardy as far north as Massachusetts.

Var. **edulis,** Voss (*P. edulis,* Engelm. *Caryopitys edulis,* Small). Nut P. Tree often to 50 feet tall; branchlets light yellowish-brown, puberulous at first: leaves 2–3, rigid, dark green, ¾–1½ inches long: cone broad-ovoid, the apophyses pyramidal, umbo with minute recurved tip. Colorado to New Mexico.—Hardy as far north as Massachusetts.

Var. **Parryana,** Voss (*P. Parryana,* Engelm. *P. quadrifolia,* Sudw.). Parry P. Tree of pyramidal habit, to 40 feet tall, round-topped in old age; branchlets puberulous, light grayish-brown: leaves 3–5, usually 4, rigid, incurved, 1½–1¾ inches long, pale glaucous-green: cone subglobose; the apophyses pyramidal, umbo with minute recurved prickle. California.—Probably not hardy north of the Middle Atlantic States.

To this group also belong two Mexican species: **P. Pinceana,** Gord., with the leaves in clusters of 3 and with cylindric cone, and **P. Nelsonii,** Shaw, fascicles with 3 partly connate serrulate leaves and a persistent sheath; cone cylindric. They are probably not now in cultivation and could be expected to be hardy only in the Southern States and southern California.

Group 5. Gerardianæ

Seed with a very short articulate wing: leaves 3, serrulate.

14. **P. Bungeana,** Zucc. Lace-Bark P. Tree to 80 or 100 feet tall, with long and slender branches; bark exfoliating in large, thin, irregular plates, leaving particolored areas, light gray, on old trees chalky-white; young

branches grayish-green, glabrous: leaves rigid, acute, light green, 2–4 inches long, with stomata on the back: cones almost sessile, conic-ovate, light yellowish-brown, 2–3 inches long; apophysis much broader than high, ridged, with a triangular pointed and recurved umbo; seed dark brown, with narrow wing, ⅓–½ inch long. Northwestern China.—Introduced to Great Britain in 1846 from the neighborhood of Peking, where it had been cultivated since ancient times. Hardy as far north as Massachusetts. A slow-growing tree usually of bushy habit in cultivation and with rather sparse light green foliage; remarkable for its exfoliating bark resembling that of the planetree, but of grayish color.

The closely related Himalayan **P. Gerardiana,** Wall., has larger cones and longer oblong-cylindric seeds. It has been repeatedly introduced to Great Britain, but is at present very rare and probably not known in this country where it would be hardy in the Southern States.

Group 6. Balfourianæ

Seeds with long wing: leaves in fascicles of 5, entire, without stomata on the back and with marginal resin-ducts; sheath gradually deciduous.

15. **P. Balfouriana,** Jeffrey. Foxtail P. Tree to 40, occasionally 90 feet tall, narrow-pyramidal when young, irregular and open in old age; bark on stems and branches of young trees thin and smooth, milky-white, on old trees thick, dark red-brown, deeply divided into broad, flat ridges covered with small appressed scales; branchlets dark brown, puberulous at first: leaves crowded, incurved and pressed against the branches, rigid, acute, dark green on the back, with conspicuous white lines on the ventral sides, 1–1½ inches long, remaining for ten to twelve years on the branches: cones pendulous, subcylindric, dark purplish-brown, 3½–5 inches long; apophysis flattened, the concave oblong umbo with minute incurved prickle; seed ⅓ inch long, with adnate wing. California.—Introduced in 1852 to Great Britain. Hardy in sheltered positions as far north as Massachusetts.

16. **P. aristata,** Engelm. (*P. Balfouriana* var. *aristata,* Engelm.). Bristlecone P. (Foxtail P.). Bushy tree occasionally to 50 feet tall, sometimes a semi-prostrate shrub; similar to the preceding species; branchlets light orange and almost glabrous: leaves stout or slender, dark green, 1–1½ inches long, with white lines on the ventral sides, usually with conspicuous scattered exudations of resin: cones cylindric-ovoid, 3–3½ inches long; apophysis elevated; umbo with a slender incurved spine to ¼ inch long; seed ¼ inch long. California to Colorado and Arizona.—Introduced in 1861 by Dr. Parry to the eastern States and Europe. Hardy as far north as Massachusetts. In cultivation usually a handsome low shrub with ascending branches densely clothed with appressed leaves sprinkled with resinous

exudation, a character by which this species is easily distinguished from other shrubby pines.

Subgenus II. DIPLOXYLON. PITCH PINES

Bracts of leaf-fascicles decurrent: sheaths persistent, rarely deciduous: leaves serrulate, with two fibro-vascular bundles and with dorsal and ventral stomata: cones with dorsal umbo: wood hard, with dark resinous bands and clearly defined annual rings: spring-shoots often multinodal (producing more than one whorl of branchlets).

Section III. Parapinaster

Sheaths of leaf-fascicles persistent or deciduous: seed-wing adnate or articulate and short. (The two Mexican species with deciduous sheaths forming the group Leiophyllæ are not in cultivation.)

Group 7. Longifoliæ

Leaves in fascicles of 3, very long; sheaths persistent: seed-wing adnate to the nut.

17. **P. longifolia,** Roxbg. (*P. Roxburghii,* Sarg.). Tree to 100 feet tall or more, with round-topped symmetrical head; bark thick, deeply fissured into large plates; branchlets light yellow-brown; winter-buds oblong, light chestnut-brown, not resinous, with fringed not recurved scales: leaves 3, slender, pendulous, light green, 8–12 inches long: cones short-stalked, conic-ovoid, 4–7 inches long; apophysis elongated-pyramidal, compressed, more or less recurved; umbo obtuse; seed ¾–1 inch long. Himalayas from Bhutan to Afghanistan on the outer slopes and foothills.—Introduced in 1801 to Great Britain. Cultivated in California and not hardy north of the Southern States. As a young plant it is very ornamental with its long, drooping, light green leaves. In its native country it is an important forest tree.

18. **P. canariensis,** C. Smith. Canary P. Fig. 82. Tree to 80 feet tall, with slender branches forming a broad round-topped head; stem and branches usually with scattered, short, leafy branchlets; bark reddish, slightly fissured into irregular scales; branchlets yellowish, pruinose when young; winter-buds oblong, not resinous, with reflexed conspicu-

82. Pinus canariensis.

ously white-fringed scales brown in the middle: leaves slender, spreading and pendulous, light green and lustrous, 9–12 inches long: cones cylindric-ovoid, 4–8 inches long; apophysis low-pyramidal, irregularly 4–sided, light brown and glossy, with obtuse umbo; seed ½ inch long. Canary Islands.—Early introduced into southern Europe. Cultivated in California where it grows faster than the native *P. radiata*, even in dry and rocky situations. Not hardy north of the Southern States, but in the North sometimes grown in greenhouses for its decorative, long, and drooping foliage.

Group 8. Pineæ

Leaves in clusters of 2, with persistent sheaths: seed-wing articulate, short, deciduous.

19. **P. Pinea**, L. Italian Stone P. Tree to 80 feet tall, with long horizontally spreading branches forming in older trees a broad flat-topped head; bark brown, smooth at first, ultimately deeply furrowed and scaly; branchlets pale brown; winter-buds with revolute scales, oblong-ovoid, not resinous: leaves rigid, acute, bright green, 5–8 inches long: cones broadly-ovoid, chestnut-brown, 4–5½ inches long, maturing the third year; apophysis depressed-pyramidal, radiately ridged; umbo flat, obtuse; seed reddish-brown, ¾ inch long, edible. Mediterranean region, from Portugal to Syria, also in North Africa.—Much planted in southern Europe from a very early period for ornament and for its edible seeds and cultivated in Great Britain since the middle of the sixteenth century. Hardy only in California and the Southern States. Older trees are of picturesque habit, with a trunk usually destitute of branches for a considerable height and with a wide-spreading parasol-like head.

Section IV. Pinaster

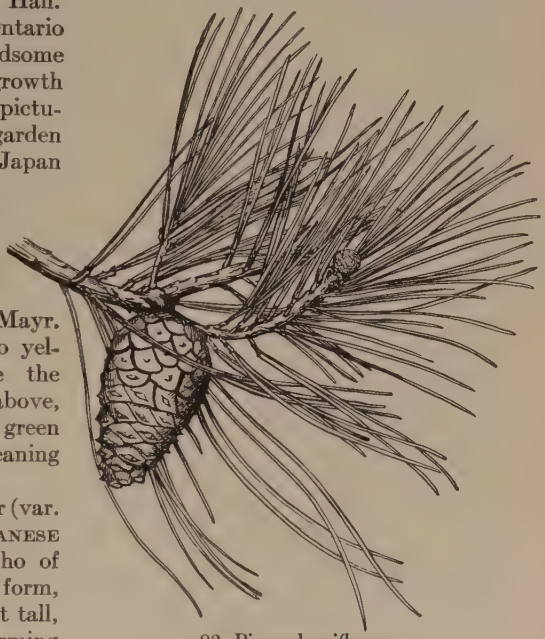
Fascicles of leaves with persistent sheaths: seed-wings long and articulate: spring-shoots uninodal or multinodal.

Group 9. Lariciones

Cones dehiscent at maturity: spring-shoots uninodal: hypoderm-cells of leaves uniform: ray-cells of wood with large pits.

20. **P. densiflora**, Sieb. & Zucc. (*P. Massoniana*, Hort., not Lamb.). Japanese Red P. Fig. 83. Plate XXXVIII. To 100 feet tall, with spreading branches forming rather broad head; bark orange-red, thin and scaly, at the base of old trunks thicker, grayish and fissured into oblong plates; branchlets orange-yellow, bloomy; winter-buds oblong-ovoid, chestnut-brown: leaves slender, acute, bright bluish-green, 3–5 inches long; cones short-stalked, conspicuously mucronate when young, conic-ovoid to oblong,

dull tawny yellow, somewhat oblique at the base, about 2 inches long; apophysis flattened and slightly ridged, those near the base sometimes elongated; umbo small, with a short prickle, or obtuse; seed grayish-yellow, ¼ inch long. Japan.—Introduced in 1854 by Siebold to Holland and in 1862 to North America by Dr. Hall. Hardy north to southern Ontario and New England. Handsome ornamental pine of rapid growth when young, often very picturesque when older. Several garden forms are cultivated in Japan and have been introduced into this country.



83. Pinus densiflora.

Var. **aurea**, Mayr. GOLDEN JAPANESE P. Foliage yellow.

Var. **oculus-draconis**, Mayr. Each leaf marked with two yellow bands, and therefore the tufts of leaves, if seen from above, show alternate yellow and green rings, hence the name, meaning dragon-eye.

Var. **umbraculifera**, Mayr (var. *tabuliformis*, Hort.). JAPANESE UMBRELLA P., the Tanyosho of the Japanese. Dwarf dense form, growing ultimately to 12 feet tall, with spreading branches forming an umbrella-like head.

Var. **globosa**, Mayr. JAPANESE GLOBE P., the Bandaisho of the Japanese. A dwarf form of globose habit.

Var. **pendula**, Mayr. WEEPING JAPANESE P. A form with pendulous or prostrate branches.

21. **P. Massoniana**, Lamb. Tree to 80 feet tall, with slender spreading branches; bark in the upper parts of the tree red and peeling off in thin strips, near the base of trunk dark gray and deeply fissured into irregular oblong plates; branchlets yellowish-brown: leaves very slender and thin, light green, 5–8 inches long: conelet with partly tuberculate or mucronate and partly with obtuse scales; cones oblong-ovoid or ovoid, nut-brown, 2–3 inches long; apophysis flattened, slightly keeled, with a small, flat, unarmed umbo; seed $\frac{1}{5}$ inch long. Southeastern to western China.—Rarely cultivated

and usually confused with the preceding species and with *P. sinensis*. Hardy probably only in the Southern States and California.

22. **P. resinosa,** Ait. Red P. (Norway P.). Tree to 70, occasionally to 150 feet tall, with stout, spreading and sometimes pendulous branches forming a broad pyramidal head when young and an open round-topped one in old age; bark of trunk divided by shallow fissures; branchlets orange-color; winter-buds ovoid, acuminate, light brown, resinous: leaves slender and flexible, acute, dark green and lustrous, 4–6 inches long: conelet with obtuse scales; cones subsessile, conic-ovoid, light brown, 1½–2½ inches long; apophysis flattened, conspicuously keeled, obtuse, with small, dark, unarmed umbo; seeds dark brown, ⅛ inch long. Newfoundland to Manitoba, south to the mountains of Pennsylvania, to Michigan, Wisconsin, and Minnesota.—Introduced to Great Britain about 1756. Hardy as far north as Saskatchewan. Ornamental pine of vigorous growth, one of the best for northern gardens; also a valuable timber-tree.

Var. **globosa,** Rehd. A dwarf dense form of globose habit. Discovered about 1910 in New Hampshire.

84. Pinus sylvestris.

23. **P. sylvestris,** L. Scotch P. (Scots P.). Fig. 84. Tree to 70 or occasionally 120 feet tall, with spreading, often somewhat pendulous branches, pyramidal when young, with broad and round-topped, often picturesque head in old age; bark on the upper part of the stem bright red, thin and smooth, peeling off in papery flakes, thick toward the base, grayish or reddish-brown and fissured into irregular, longitudinal, scaly plates; branchlets dull grayish-yellow; winter-buds oblong-ovoid, brown, resinous, the scales free at the apex: leaves rigid, acute, twisted, bluish-green, 1½–3 inches long: conelet reflexed with minutely mucronate scales; cones short-stalked, conic-oblong, grayish- or reddish-brown, 1½–2½ inches long; apophysis little thickened, slightly keeled, only those near the base

elongated; umbo small, obtuse; seed dark gray, 1/6 inch long. Europe to western Asia and northeastern Siberia.—Early introduced into this country and naturalized in some places on the New England coast. Hardy as far north as Quebec and precariously so to Saskatchewan. Several garden forms of comparatively little importance are in cultivation.

Var. **argentea,** Stev. Leaves light bluish-green of silvery hue. Var. **aurea,** Beiss. Golden Scotch P. The young leaves golden-yellow, changing the second year to green; of slow growth and rather dense habit.

Var. **fastigiata,** Carr. (var. *pyramidalis,* Hort.). With ascending branches forming a narrow pyramidal head. Var. **Watereri,** Rehd. (*P. Wateriana,* Hort.). Waterer P. Dense columnar form with short steel-blue leaves. f. **pendula,** Casp. With pendulous branches. Var. **pumila,** Beiss. Dwarf globose bush.

Of the geographical forms the best known and silviculturally of the most importance is var. **rigensis,** Loud. A form with very red bark and straight tall stem. Var. **scotica,** Beiss., is similar, but the bark is redder and the leaves more glaucous and shorter, about 1½ inches long. Var. **lapponica,** Fries (*P. lapponica,* Mayr), is a form of northern Europe. Of more narrow-pyramidal habit: leaves broader and shorter, remaining green on the branches for four to seven years: cones more yellowish. Var. **engadinensis,** Heer, is a form of the higher mountains of Tyrol. Slow-growing pyramidal tree with grayish-green, thick and rigid leaves 1–1½ inches long.

24. **P. Mugo,** Turra (*P. montana,* Mill.). Swiss Mountain P. Very variable in habit, usually low, often prostrate shrub, sometimes pyramidal tree to 40 feet tall, similar to the preceding; scales of winter-buds appressed; branchlets usually of darker brownish color: leaves bright green, acutish, stout, crowded, ¾–2 inches long: conelet nearly sessile with mucronate scales; cones tawny-yellow to brown, ovoid or conic-ovoid, ¾–2¼ inches long; apophysis often pyramidal; umbo light gray, surrounded by a blackish ring. An anatomical character in the leaves to distinguish this species from the preceding is found in the cells of the epidermis which are of nearly equal diameter, with a dot-like central space in *P. sylvestris,* but in this species are much higher than broad with a dash-like central space. Mountains of central and southern Europe, from central Spain to the Balkan mountains.—Introduced into cultivation the second half of the eighteenth century. Hardy as far north as eastern Canada and precariously so to Saskatchewan. Handsome low shrub with ascending branches densely clothed with bright green foliage; well adapted to be planted as single specimens on the lawn or on rocky slopes and as undergrowth in open woods. A very variable species, usually divided according to the cones into the following four varieties or subspecies.

Var. **Mughus,** Zenari (*P. montana* var. *Mughus,* Willk. var. *prostrata,*

Tubeuf, *P. Mughus*, Scop.). Mugho P. Cone symmetrical, 1–1½ inches long, conical or conic-oval, with much-flattened apophyses and usually prickly umbo, not bloomy, yellowish-brown before ripening, cinnamon-brown when ripe. Usually shrubby and prostrate. Eastern Alps to Bosnia.

85. Pinus Mugo var. pumilio.

Var. **pumilio,** Zenari (*P. montana* var. *pumilio*, Willk. var. *frutescens erecta*, Tubeuf. *P. pumilio*, Haenke. *P. carpatica*, Hort.). Bush P. Fig. 85. Cone symmetrical, subglobose to ovoid, before maturity glaucous and usually violet-purple, ripe yellowish- or dark brown. Usually shrubby and upright. Mountains of Germany to the Alps and Balkan Peninsula.

Var. **rotundata,** Hoopes (*P. montana* var. *rotundata*, Willk. *P. rotundata*, Link). Cone oblique and asymmetrical, conical or ovoid, 1½–2 inches long, spreading or bent downward, with the lower and occasionally the middle scales on the outer side ending in a short and blunt slightly reflexed pyramidal apophysis. Usually a tree to 30 feet tall, with several stems. Mountains of Germany, Carpathian Mountains, and Alps.

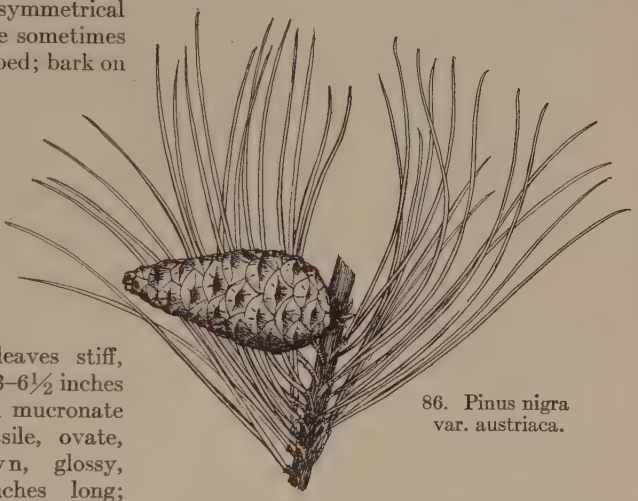
Var. **rostrata,** Hoopes (*P. montana* var. *uncinata*, Willk. var. *arborea*, Tubeuf. var. *rostrata*, Willk. *P. uncinata*, Ram.). Cones asymmetrical and very oblique, conic-ovoid, 2–2½ inches long, directed downward; the scales on the outer side strongly developed, their much-elongated pyramidal apophyses ending in hook-like processes directed toward the base of the cone. Usually a tree with a single stem, sometimes to 80 feet tall. Pyrenees to western Alps.

A few garden forms belonging to the first two varieties are in cultivation. Var. **compacta,** D. Hill, is a handsome form of dense almost subglobose habit with slender bright green leaves.

25. **P. leucodermis,** Ant. (*P. Laricio* var. *leucodermis*, Christ. *P. nigra* var. *leucodermis*, Rehd.). Graybark P. Tree to 60 feet tall, of regular pyramidal habit; bark light gray, broken into angular plates; branchlets bloomy when young, grayish-white the second and third year; winter-buds oblong-ovoid, not resinous, the scales brown with white tips or almost grayish-white: leaves more or less appressed and incurved toward the branch, stiff, 1½–2½ inches long, pungent or obtusish, bright green: cone ovoid, about 3 inches long, similar to that of *P. nigra*, but yellowish or light brown, scarcely

lustrous. Balkan Peninsula.—Rare in cultivation and often confused with the following species and of about the same hardiness.

26. **P. nigra,** Arnold (*P. Laricio,* Poir.). Austrian P. Plate XLII. Tree to 100 or occasionally 150 feet tall, with stout spreading branches in regular whorls forming a symmetrical pyramid, in old age sometimes broad and flat-topped; bark on old trees deeply fissured into irregular longitudinal scaly plates, pale brown beneath the deciduous scales; branchlets usually light brown; winter-buds ovoid or oblong-ovoid, light brown, resinous: leaves stiff, acute, dark green, 3–6½ inches long: conelet with mucronate scales; cones sessile, ovate, yellowish-brown, glossy, usually 2–3½ inches long; apophysis depressed, conspicuously keeled; umbo flattened, obtuse or with a very short prickle; seeds gray, ¼ inch. From Austria, Sicily, and Corsica to western Asia.—Introduced about 1759 to Great Britain. The typical form (var. *austriaca*) is hardy as far north as southern Ontario and New England. A handsome vigorous pine of regular habit with stout spreading branches and long dark green leaves. A variable species of which several geographical varieties have been distinguished.

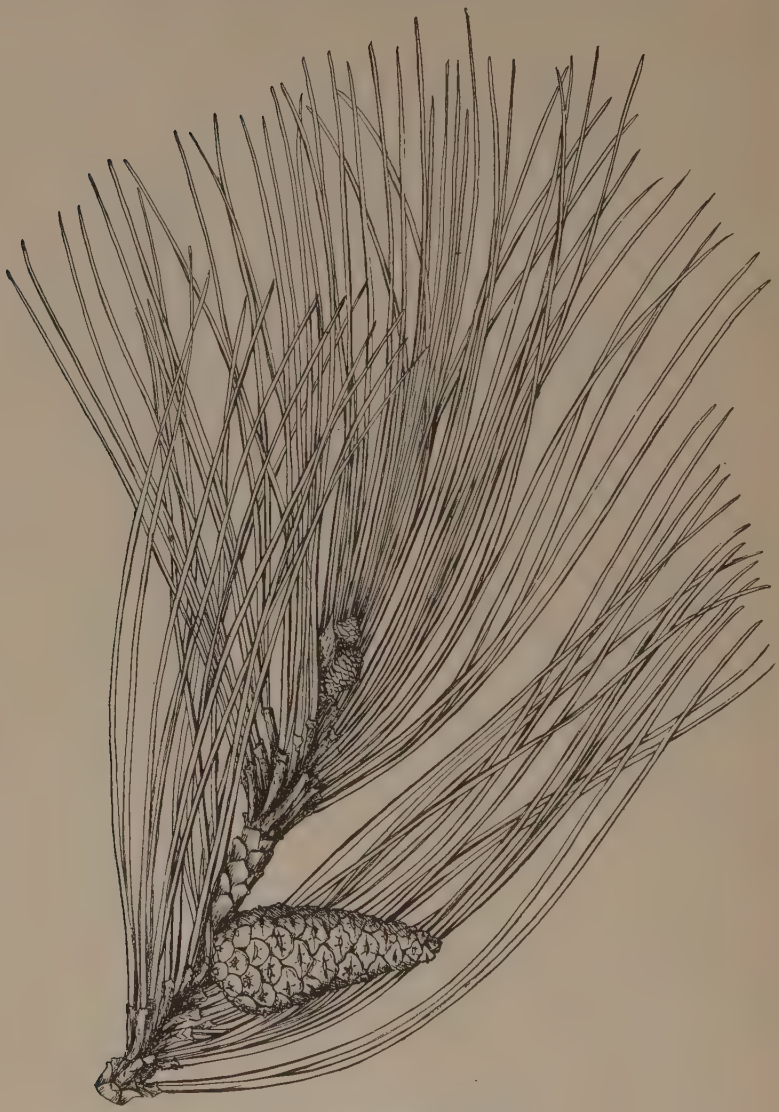


86. Pinus nigra var. austriaca.

Var. **austriaca,** Asch. & Graebn. (*P. Laricio* var. *austriaca,* Endl. *P. austriaca,* Höss. *P. nigricans,* Hort.). Fig. 86. Tall tree, with dark gray bark, broadly ovate head and very dark green rigid leaves 3–4 inches long: branchlets grayish- or yellowish-brown. Southeastern Europe, from Austria to Dalmatia and Rumania.

Var. **Pallasiana,** Asch. & Graebn. (*P. Pallasiana,* Lamb.). Crimean P. Tall tree, with long and stout branches: leaves dark green and glossy: cones light brown, about 4 inches long, with the upper and middle apophyses obtusely keeled. Western Asia.

Var. **Poiretiana,** Asch. & Graebn. (*P. Laricio,* Poir. *P. Laricio* var. *Poiretiana,* Ant. *P. nigra* var. *calabrica,* Schneid. *P. Laricio corsicana,* Hort.). Corsican P. Tall tree to 150 feet high, with shorter ascending branches



87. Pinus nigra var. cebennensis.

forming a narrower head; bark gray; branchlets reddish-brown: leaves lighter green, 4–6 inches long, less crowded and variously curved: cone with the upper and middle apophyses obtusely keeled. Southern Europe.

Var. **cebennensis,** Rehd. (var. *leptophylla*, Asch. & Graebn. var. *tenuifolia*, Asch. & Graebn. *P. Laricio tenuifolia*, Parl. *P. Salzmannii*, Dun. *P. monspeliensis*, Salzmann, *P. cebennensis*, Hort. *P. horizontalis*, Hort.). Fig. 87. Tree to 60 feet tall; branchlets orange-colored: leaves slender, to 6½ inches long: cones small, about 2 inches long. Southwestern France, Pyrenees.—This is the most distinct variety; of looser and thinner habit and with very long and slender leaves.

There are a few horticultural varieties of little importance, as var. **pendula,** Rehd. (*P. Laricio pendula*, Beiss.), with pendulous branches; var. **pygmæa,** Rehd. (*P. Laricio pygmæa*, Rauch); and var. **prostrata,** Rehd. (*P. Laricio prostrata*, Beiss.), with prostrate branches.

27. **P. Thunbergii,** Parl. (*P. Massoniana*, Sieb. & Zucc., not Lamb.). Japanese Black P. Fig. 88. Plate XXXVIII. To 100 or even 120 feet tall, with spreading, often somewhat pendulous branches, forming a broad pyramidal, often irregular head; bark blackish-gray, fissured into elongated irregular plates; branchlets orange-yellow; winter-buds oblong, grayish- or silvery-white, with fimbriate scales, free at the tips: leaves stiff, sharply pointed, bright green, 3–4½ inches long: cones short-stalked, conic-ovate, grayish-brown, 2–3 inches long; apophysis flattened, with small depressed umbo, obtuse or with

88. Pinus Thunbergii.

a minute prickle; seed grayish-brown, ¼ inch long. Japan.—Introduced to Holland in 1855. Hardy as far north as New England and southern Ontario. A handsome, picturesque tree with wide-spreading branches forming a broad irregular head.

Of the several garden forms cultivated in Japan, one of the best is var. **oculus-draconis,** Mayr, with the leaves marked with two broad yellow bands similar to the variety of the same name of *P. densiflora.*

28. **P. sinensis,** Lamb. (*P. leucosperma,* Maxim. *P. funebris,* Komar. *P. Henryi,* Mast. *P. Wilsonii,* Shaw. *P. tabuliformis,* Carr.). China P. Tree to 70 feet tall; bark of trunk dark gray, fissured, red on the limbs; branchlets pale orange-yellow or pale grayish-yellow, slightly bloomy while young; winter-buds oblong, light brown, lustrous, slightly or not resinous: leaves 2–3, oftener 2, stiff, glaucescent, with rough margins, 2–4 inches long: cones subsessile, ovoid, 1½–2½ inches long, persistent for several years, pale yellow-brown; apophysis rhombic, prominently keeled, with an obtuse or mucronate umbo; seeds brown, mottled or whitish, over ¼ inch long, with the wing ¾ inch long. Northern to central and western China.—Introduced in 1919 by E. H. Wilson to the Arnold Arboretum where it has proved hardy in sheltered positions.

Var. **densata,** Shaw (*P. densata,* Mast. *P. prominens,* Mast.). Leaves usually 2, 3–5 inches long, stiff: cones ovoid, 2–2½ inches long, oblique, with their posterior apophysis tumid and prominent.

Var. **yunnanensis,** Shaw (*P. yunnanensis,* Franch.). Yunnan P. Leaves oftener 3, slender, 4–8 inches long: cones 2½–3½ inches long; apophysis flat; umbo small; seed with wing nearly 1 inch long. Southwestern China.

Group 10. Australes

Cones dehiscent at maturity: spring-shoots uninodal or multinodal: hypoderm-cells of the leaf biform or variable: ray-cells of the wood with small pits.

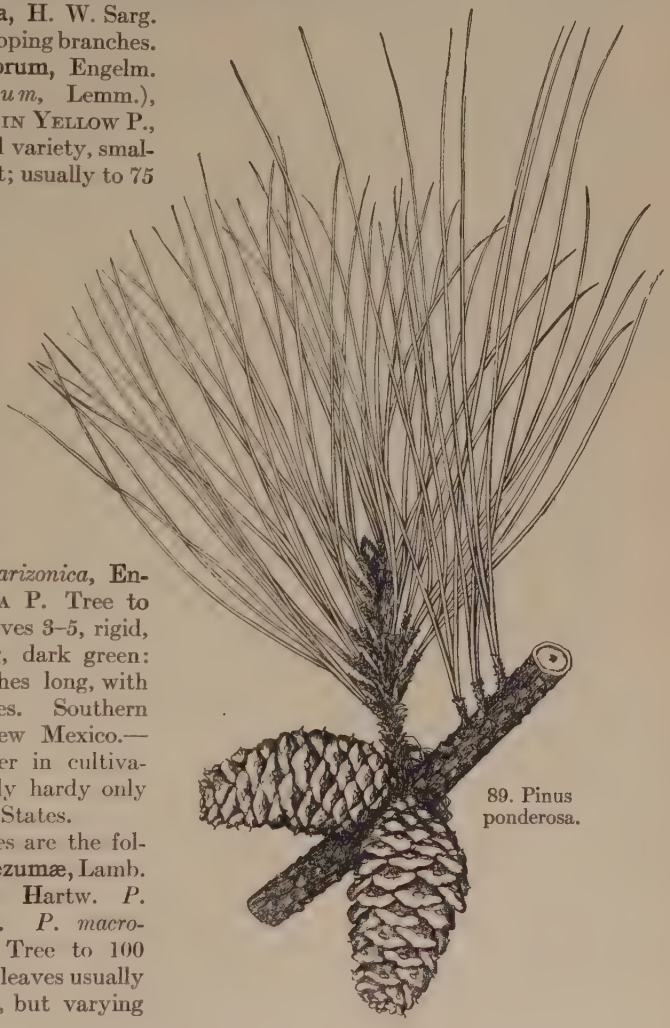
29. **P. ponderosa,** Dougl. (*P. Benthamiana,* Hartw.). Western Yellow P. (Bull P.). Fig. 89. Tree to 150, occasionally to 230 feet tall, with stout, spreading and often pendulous branches usually ascending at the ends and forming a narrow spire-like head; bark very variable, dark brown or nearly black to cinnamon-red, fissured into rounded ridges or on old trees into large plates, separating into thick cinnamon-red scales; branchlets orange-brown, fragrant when broken; winter-buds oblong-ovoid or ovoid, resinous: leaves acute, dark green, 5–11 inches long: cones almost sessile, often in clusters, ovoid-oblong, light reddish or yellowish-brown and lustrous, 3–6 inches long; apophysis depressed-pyramidal or flattened, with a broadly triangular umbo terminated by a stout, usually recurved prickle; lower scales

with more elongated apex; seed ¼ inch long. British Columbia to Mexico, east to South Dakota.—Introduced to Great Britain in 1827. Hardy in sheltered positions as far north as Massachusetts. One of the tallest pines and most important timber trees of the Western States.

Var. **pendula**, H. W. Sarg. A form with drooping branches.

Var. **scopulorum**, Engelm. (*P. scopulorum*, Lemm.), Rocky Mountain Yellow P., is a geographical variety, smaller in every part; usually to 75 feet tall, with nearly black furrowed bark: leaves 3–6 inches long, sometimes in 2's: cones smaller, ovoid. South Dakota to Mexico and Texas.—Somewhat hardier than the type.

Var. **arizonica**, Shaw (*P. arizonica*, Engelm.). Arizona P. Tree to 100 feet tall: leaves 3–5, rigid, 5–7 inches long, dark green: cones 2–2½ inches long, with recurved prickles. Southern Arizona and New Mexico.—Doubtful whether in cultivation and probably hardy only in the Southern States.



89. Pinus ponderosa.

Related species are the following: **P. Montezumæ**, Lamb. (*P. Gordoniana*, Hartw. *P. Grenvilleæ*, Gord. *P. macrophylla*, Lindl.). Tree to 100 feet tall or more: leaves usually in fascicles of 5, but varying

from 3–8, bluish-green or green, 5–12 inches long: cone conic-ovoid to long-conic, 2–12 inches long; apophyses depressed-pyramidal to nearly flat, with a short deciduous prickle. Mexico to Guatemala.—Introduced in 1809 to Great Britain; not known to be in cultivation in this country and probably hardy only south. Var. **Hartwegii,** Engelm. (*P. Hartwegii,* Lindl.), a form of the higher mountains of central Mexico with short leaves and small nearly black cones, is probably the hardiest of the varieties.

P. Teocote, Schlecht. Tree to 90 feet tall; branchlets bloomy; winter-buds cylindric-ovoid, resinous, with the scales free at the tips: leaves rigid, 3, 4–8 inches long: cones cylindric-ovoid, about 2½ inches long, dull brown or slightly shining, soon falling; apophyses slightly raised, transversely ridged with ashy-gray usually depressed umbo with a minute often obsolete prickle. Mexico.—Introduced to Great Britain in 1839 by Hartweg.

30. **P. Jeffreyi,** Balfour (*P. ponderosa* var. *Jeffreyi,* Vasey). Jeffrey P. Tree to 120 or occasionally to 180 feet tall, with short, spreading, or often pendulous branches, the uppermost ascending, forming an open pyramidal and sometimes narrow spire-like head; bark cinnamon-red, broken into large irregular plates; young branchlets glaucous, fragrant when broken; winter-buds oblong-ovoid, not resinous: leaves stout, acute, pale bluish-green, 5–8 inches long: cones conic-ovoid, light brown, 6–12 inches long; apophysis depressed, keeled; umbo elongated into a slender recurved spine; seed about ½ inch long. Oregon to California.—Introduced to Great Britain in 1853 by Jeffrey. Hardy in sheltered positions as far north as Massachusetts. A distinct and ornamental pine of symmetrical habit when young, remarkable for its long leaves, longer than in any other of the hardier species.

31. **P. echinata,** Mill. (*P. mitis,* Michx.). Shortleaf P. (Spruce P. Yellow P.). Plate XXXVIII. To 100 or 120 feet, with often pendulous branches in regular whorls; bark broken into large irregular plates covered with small, appressed, light cinnamon-red scales; winter-buds oblong-ovoid, brown: leaves 2, slender, acute, dark bluish-green, sometimes in 3's, 3–5 inches long: cones short-stalked or almost sessile, conic-oblong, dull brown, 1½–2 inches long; apophysis flattened; umbo little elevated, with short, straight or curved, slender prickle; seeds ⅕–¼ inch long. Long Island to Florida, Illinois, and Texas.—Introduced to Great Britain in 1739. Hardy as far north as Massachusetts. A handsome tree with broad ovoid head.

32. **P. glabra,** Walt. Cedar P. Pyramidal tree to 100 feet tall; bark of young trees and the upper part of old trunks smooth, pale gray, the lower part shallowly fissured; branchlets slender, light red tinged purplish, finally dark reddish-brown; winter-buds conic-cylindric, brown, resinous scales, with pale, fimbriate, interlaced margin: leaves 2, soft and slender, 1½–3 inches long, marked with numerous rows of stomata: cone reflexed, on short stout stalks, broadly ovoid to oblong-ovoid, 1½–2½ inches long, reddish-brown,

with slightly thickened or flat apophyses armed with minute, usually deciduous prickles. South Carolina to middle Florida and Louisiana.—Apparently not in cultivation in Europe and hardy only in the Southern States.

33. **P. Tæda,** L. Loblolly P. (Old Field Pine. Frankincense Pine). Tree to 100, occasionally to 170 feet tall, with spreading branches, the upper ascending, forming a compact round-topped head; bark bright red-brown, fissured into broad flat ridges covered with large, thin, appressed scales; branchlets yellowish-brown, sometimes slightly bloomy; winter-buds oblong, resinous: leaves slender but stiff, acute, bright green, 6–9 inches long: cones sessile, spreading, conic-oblong, light reddish-brown, 3–5 inches long; apophysis flattened or depressed-pyramidal; umbo small, with stout and short, triangular, recurved spine, lower scales not elongated; seed ⅓ inch long. New Jersey to Florida and Texas.—Introduced to Great Britain before 1713. Hardy as far north as southern New York. Rarely cultivated for ornament, but an important timber-tree, particularly in the region west of the Mississippi River.

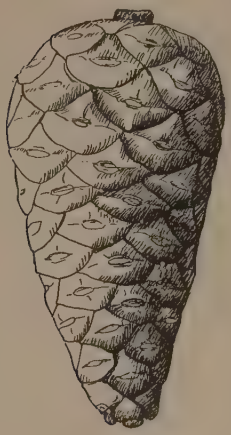
34. **P. palustris,** Mill. (*P. australis,* Michx.). Longleaf P. (Southern P.). Tree to 100 or 120 feet tall, with ascending branches forming an oblong open head; bark light orange-brown, separating into large, appressed, papery scales; branchlets orange-brown; winter-buds white, oblong: leaves crowded, forming tufts at the end of branchlets, dark green, 8–18 inches long, with internal resin-ducts: cones almost sessile, cylindric, dull brown, 6–10 inches long; apophysis flattened; umbo dark brown, with triangular, reflexed, short spines; seed almost ½ inch long. Virginia to Florida and Mississippi, along the coast.—Introduced to Great Britain about 1730. Hardy only in the Southern States. Branches are imported in great quantities into the northern cities and used for decoration on account of their long handsome foliage. It is the most important timber-tree of the southeastern States and yields excellent resin in great quantities, the source of a large part of the world supply of the naval stores.

35. **P. caribæa,** Morelet (*P. cubensis,* Griseb. *P. heterophylla,* Sudw. *P. Elliottii,* Engelm.). Slash P. (Swamp P.). Tree to 100 or 120 feet tall, with horizontally spreading branches forming a round-topped, broad and compact head; bark separating freely into large thin scales; branchlets orange-brown; winter-buds cylindric, light brown: leaves dark green and lustrous, acute, in 3's and 2's, 8–12 inches long, with internal resin-ducts: cones short-peduncled, conic-oblong, dark brown and glossy, 3–6½ inches long; apophysis flattened, keeled; umbo small, with minute recurved prickles; seed ⅙–¼ inch long. Georgia to Florida, and eastern Louisiana near the coast, also on the Isle of Pines near Cuba, and in Honduras and eastern Guatemala.—Apparently not in cultivation in Europe. Hardy only in the Southern States.

Group 11. Insignes

Cones tenaciously persistent, often serotinous (remaining closed after maturity for years): ray-cells of wood with small pits.

36. **P. halepensis,** Mill. (*P. alepensis,* Poir. *P. pityusa,* Stev.). Aleppo P. Fig. 90. Tree to 60 feet tall, with short branches forming an open round-topped head; bark gray, smooth for a long time, finally fissured and exposing the reddish-brown inner bark; branchlets slender, yellowish- or light greenish-brown; winter-buds small, cylindric, not resinous: leaves sometimes in 3's, slender, light green, 2½–4 inches long: cones short-stalked, spreading or deflexed, usually 1–3, conic-ovate or conic-oblong, yellowish-brown, unarmed, 2½–3½ inches long; apophysis flattened, with a transverse line and slightly or not elevated obtuse umbo; seed ¼ inch long. Mediterranean region, from Portugal and Algeria to Afghanistan.—Recommended for seaside planting and much planted in Europe. Cultivated in California; in the East probably not hardy north of the Southern States. Of little ornamental value; the trunk usually slender and destitute of branches for a considerable height and the foliage thin and sparse, in tufts at the end of the branchlets.



90. Pinus halepensis.

Var. **brutia,** Henry (*P. brutia,* Ten. *P. eldarica,* Medw. *P. pyrenaica,* Lapeyr.). Leaves 4–7, rarely 8 inches long, more rigid, bright or dark green: cones sessile, not deflexed, usually in whorls of 2–6, 2–4 inches long, with rugose depressed knobs.

37. **P. Pinaster,** Ait. (*P. maritima,* Poir.). Cluster P. Tree to 100 feet tall, with spreading or sometimes pendulous branches forming a pyramidal head; bark deeply fissured into narrow longitudinal ridges covered with small scales; branchlets bright reddish-brown; winter-buds oblong-oval, brown, not resinous: leaves stiff, acute, usually twisted, glossy green, 5–9 inches long: cones short-peduncled, clustered, conic-oblong, light brown and glossy, 4–7 inches long; apophysis pyramidal, conspicuously keeled with prominent triangular acute umbo; seed grayish-brown, ⅓ inch long. Southern Europe and Algeria near the coast.—Much used in southern Europe, particularly in southern France, and also in South Africa and Australia for the reforestation of sand-dunes; in Europe it is chiefly exploited for resin and turpentine. Probably not hardy north of the Southern States and California. A handsome pine of regular pyramidal habit and of rapid growth.

38. **P. pungens,** Lamb. Table Mountain P. (Poverty P.). Tree to 30,

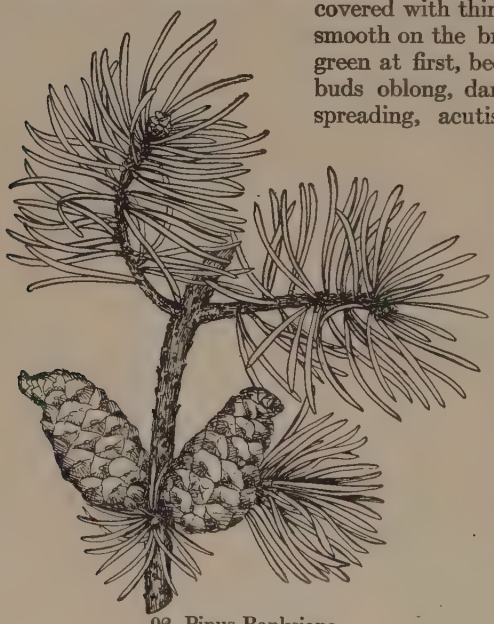
occasionally to 60 feet tall, with stout spreading branches forming a broad, open, often flat-topped head; bark dark brown, thick, broken into irregular plates covered with thin scales, on the upper part of trunk and on the branches separating into thin loose scales; branchlets light orange; winter-buds oblong, obtuse, dark chestnut-brown: leaves stout, twisted, sharply pointed, dark green, 1¼–2½ inches long: cones conic-ovoid, oblique at the base, light brown, 2½–3½ inches long; apophysis pyramidal and conspicuously keeled, the conical elongated umbo ending in a stout curved spine; seed light brown, ¼ inch long. From New Jersey and eastern Tennessee to northern Georgia.—

91. Pinus virginiana.

Introduced to Great Britain about 1804. Hardy as far north as Massachusetts, but of little ornamental value.

39. **P. clausa,** Vasey (*P. inops* var. *clausa,* Engelm.). Sand P. (Spruce P.). Tree to 20, occasionally to 70 feet tall, with slender spreading branches; bark on the branches and on the upper part of the trunk smooth and ashy-gray, on the lower part deeply fissured into oblong plates covered with red-brown scales; branchlets red-brown; winter-buds oblong, obtuse, not or little resinous: leaves slender and flexible, acute, dark green, 2–3 inches long: cones short-stalked, often oblique at the base, conic-ovoid, dark reddish-brown, 2–3½ inches long, remaining closed for three or four years after ripening and occasionally becoming enveloped by the growing wood of the stem; apophysis depressed-pyramidal, conspicuously keeled; umbo with a short stout spine. Florida and Alabama, near the coast.—Little known in cultivation; hardy only south.

40. **P. virginiana,** Mill. (*P. inops,* Ait.). Scrub P. (Jersey P.). Fig. 91. Tree to 40 or sometimes to 100 feet tall, with slender horizontal or pendulous branches in remote and irregular whorls, forming a broad open pyramid or sometimes flat-topped; bark of trunk shallowly fissured into plate-like scales covered with thin, appressed, dark brown scales, smooth on the branches; branchlets usually pale green at first, becoming purple, bloomy; winter-buds oblong, dark brown: leaves stiff, twisted, spreading, acutish, 1½–3 inches long: cones conic-oblong, reddish-brown, 1½–2½ inches long; apophysis little elevated, with a broad depressed-pyramidal umbo ending in a short recurved prickle; seed pale brown, ¼ inch long. New York to Georgia, west to Ohio, Indiana, northeastern Mississippi and Alabama.—Introduced to Great Britain before 1739. Hardy as far north as Massachusetts. A tree with slender wide-spreading branches, of little ornamental merit, but valuable for covering dry and barren soil.



92. Pinus Banksiana.

41. **P. Banksiana,** Lamb. (*P. divaricata,* Dum.-Cours.).

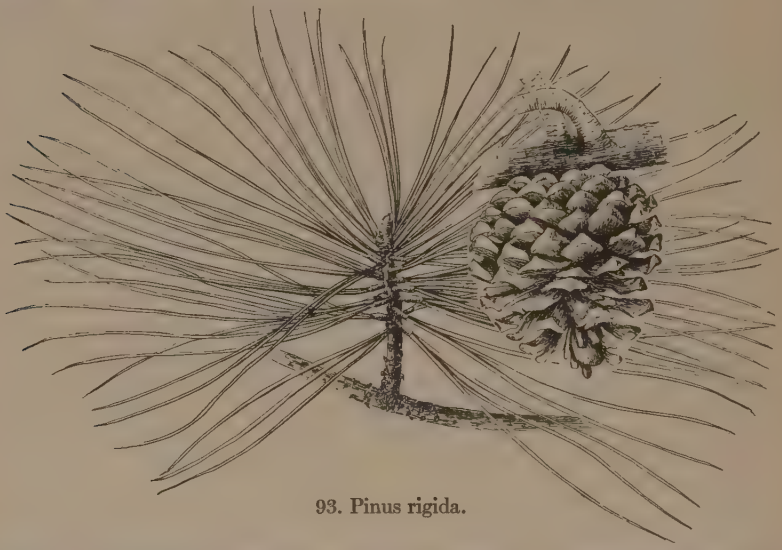
Jack P. Fig. 92. Tree to 70 feet tall, usually lower, sometimes shrubby, with slender spreading branches, forming a broad open head; bark dark brown, slightly tinged with red, divided into irregular narrow ridges covered with thick appressed scales; branchlets yellowish- to purplish-brown; winter-buds oblong-ovoid, light brown, very resinous: leaves stiff, twisted, spreading, flat or slightly concave on inner face, about $\frac{1}{1\frac{1}{2}}$ inch broad, acute or obtusish, dark or bright green, about 1 inch long: cones conic-oblong, usually curved, pale yellow-brown and lustrous, unarmed, 1½–2 inches long, remaining on the tree for twelve to fifteen years; apophysis flattened, with a transverse line and a small dark obtuse umbo; seed black, ⅜ inch long. From Nova Scotia to Mackenzie, south to northern New York, northern Illinois, and Minnesota.—Introduced to Great Britain before 1873. The hardiest of the American pines and valuable for colder regions, particularly for planting on dry and sandy soil; of little ornamental value, but older trees often present a picturesque aspect.

42. **P. contorta,** Dougl. (*P. Bolanderi,* Parl. *P. contorta* var. *Bolanderi,* Koehne). Shore P. Tree to 20, occasionally to 30 feet tall, with rather stout branches forming a round-topped, compact, or open head; bark deeply and irregularly divided into small oblong plates covered with appressed dark red-brown scales tinged with purple or orange; branchlets light orange or orange-brown; buds ovoid, dark chestnut-brown, resinous: leaves stiff, twisted, acutish, dark green, 1–2 inches long: cones ovoid or conic-ovoid, very oblique at the base, often remaining closed for several years after maturity, 1–2 inches long, light yellowish-brown and lustrous, scales of the upper side with elevated pyramidal apex, the dark umbo ending in a slender incurved spine. Alaska to California, and the variety east to Montana and Colorado.—Introduced in its typical form to Great Britain about 1855, and the variety about 1853. The variety is hardy as far north as southern Ontario and New England, while the type is tenderer. This pine is without particular ornamental merit.

Var. **latifolia,** Engelm. (*P. Murrayana,* Balfour. *P. contorta* var. *Murrayana,* Engelm. *P. Boursieri,* Carr.). Lodge-Pole P., is the form in the Rocky Mountains and a taller tree of pyramidal habit, to 80, or occasionally to 150 feet tall, with orange branchlets, lighter green leaves 1½–3½ inches long, and with less oblique cones; bark thin, close, light orange-brown, covered with thin loosely appressed scales.—The commonest coniferous tree of the northern Rocky Mountains, often forming forests of great extent. It plays an important part in the natural regeneration of the forests of that region.

43. **P. muricata,** Don. Bishop P. (Prickle-cone P.). Tree to 50, occasionally to 90 feet tall, with stout spreading branches forming a regular pyramid in young trees, in old age usually round-topped and compact;

bark on lower part of trunk broken into irregular plates covered with thin loose dark brown scales tinged with red, on the upper part and on the branches broken into thin loose scales; branchlets orange-brown; winter-buds cylindric, dark chestnut-brown, very resinous: leaves stiff, usually twisted, acute, dark green, 4–7 inches long: cones usually clustered, oblong-ovoid, oblique at the



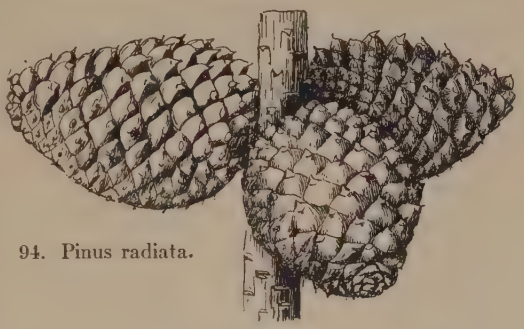
93. Pinus rigida.

base, chestnut-brown, 2–3½ inches long; scales of the upper side with elongated conical apex terminated by a dark, triangular, spiny umbo, scales of the lower side more flattened, with slender straight spines; the cones usually remain closed for several years after maturity; seeds almost black, ¼ inch long. California.—Introduced to Great Britain in 1846 by Hartweg. Hardy only in the Southern States. A handsome pine of regular pyramidal habit when young.

44. **P. rigida,** Mill. Pitch P. Fig. 93. Tree to 80 feet tall, with horizontally spreading branches forming an open irregular pyramid; bark of old trunk deeply and irregularly fissured into broad flat ridges covered with dark red-brown scales, often tinged purple, on young stems thin and broken into plate-like scales; branchlets light brown; winter-buds ovoid or ovoid-oblong, chestnut-brown: leaves stiff and spreading, acuminate, dark green, 2–5 inches long: cones almost sessile, often in clusters, ovoid, light brown, 2–4 inches long; apophysis little elevated; umbo triangular, ending in a slender, recurved prickle; seed dark brown, ¼ inch long, its wing ¾ inch

long. Maine to Ontario and Ohio, south to northern Georgia and Tennessee. —Introduced to Great Britain prior to 1759. Hardy as far north as eastern Canada. Of rapid growth when young and valuable for planting on dry and rocky soil; old trees are often very picturesque. It sprouts readily from stumps when cut down or partly destroyed by fire, but the sprouts are short-lived and never develop into trees.

Var. **serotina,** Loud. (*P. serotina*, Michx.). Pond P. (Marsh P.). Usually a tree 40–50 feet, or occasionally to 80 feet tall, with stout, often contorted branches forming an open round-topped head; bark shallowly fissured into small plates; branchlets dark orange, later dark brown: leaves 3, rarely 4, slender, 6–8 inches long: cones ovoid, 2–2½ inches long, with slender, incurved, mostly deciduous prickles; seed ⅛ inch long. New Jersey to Florida and central Alabama.—Little known in cultivation and probably not hardy north of the Middle Atlantic States.



94. Pinus radiata.

45. **P. radiata,** Don (*P. insignis*, Douglas. *P. montereyensis*, Hort.). Monterey P. Fig. 94. Tree to 100 or to 140 feet under favorable conditions in cultivation, with stout spreading branches forming an irregular, open, round-topped head; bark thick, deeply furrowed into broad flat ridges covered with thick appressed scales, dark red-brown; branchlets brown; winter-buds ovoid, bright chestnut-brown: leaves acute, bright green, 4–6 inches long: cones short-stalked, conic-ovoid, 3–7 inches long, upper scales with elevated, rounded, almost hemispherical and obscurely keeled apex; umbo small, with minute, straight, or recurved prickle, lower scales with almost flattened apex; seed black, ¼ inch long. Southern to Lower California.—Introduced to Great Britain about 1833 by D. Douglas. Hardy only in the Southern States. A handsome species with bright green foliage and of rapid growth when young; valuable for seaside planting. Now extensively planted for reforestation purposes in Australia and New Zealand where it grows more rapidly and taller than in California.

46. **P. attenuata,** Lemm. (*P. tuberculata*, Gord., not Don. *P. californica*, Hartw., not Loisel.). Knob-cone P. Tree usually only 20, but occasionally to 100 feet tall, with slender horizontal branches ascending at the ends, forming a broad pyramid, with open round-topped head in old age; bark of

young stems and branches thin and smooth, pale brown, at base of old trunks dark brown and shallowly fissured into large loose scales; young branchlets slender, dark orange-brown; winter-buds oblong-ovoid, dark brown: leaves slender, acuminate, pale yellowish or bluish-green, 3–7, usually 4–5 inches long: cones short-stalked, usually in clusters, elongated-conical, 3½–6 inches long, upper scales with pyramidal apex and prominent sharply pointed and recurved umbo, lower scales with depressed apex and small prickly umbo; seed ¼ inch long. Oregon to California.—Introduced in 1847 by Th. Hartweg to Great Britain. Not hardy north of the Southern States. In cultivation usually a bushy tree with sparse dull foliage.

A related species is **P. patula,** Schlecht. & Cham. Tree to 80 feet tall, with stout spreading branches; bark grayish-brown, irregularly fissured, the upper part of the trunk and the branches red, with deciduous scales; branchlets slender, pruinose, becoming light reddish-brown: leaves usually 3, sometimes 4–5, slender and drooping, 9–12 inches long, grass-green: cones in clusters, conic-ovoid, 3–4½ inches long; apophyses nut-brown, tumid, keeled, with a flat or depressed unarmed umbo. Central Mexico.—Introduced about 1828 to Europe. Doubtful whether in cultivation in this country; hardy only south. One of the most ornamental pines resembling the Himalayan *P. longifolia,* but hardier.

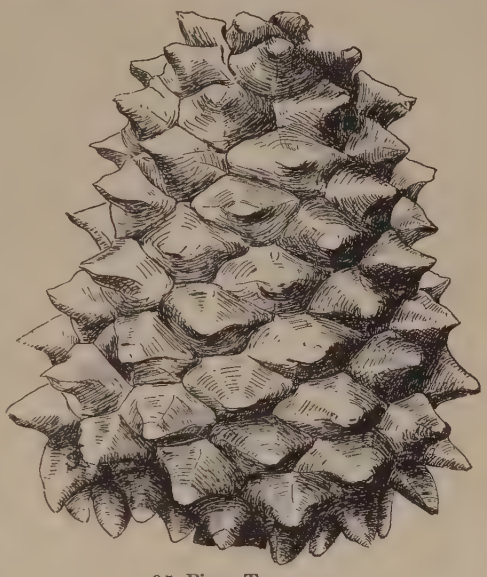
Group 12. Macrocarpæ

Cones large, with pointed prominent apophyses; seeds with a thick wing: leaves long and stout: spring-shoots multinodal or uninodal in No. 49: ray-cells of wood with small pits.

47. **P. Coulteri,** D. Don (*P. macrocarpa,* Lindl.). Coulter P. Tree to 80 feet tall, with stout branches, pendulous below and ascending above, forming a loose pyramidal head; bark dark brown or nearly black, deeply divided into broad rounded ridges covered with thin appressed scales; winter-buds oblong-ovoid, resinous: leaves stout, acuminate, dark bluish-green, 6–12 inches long: cones short-stalked, pendent, cylindric-ovoid, yellowish-brown, 9–14 inches long; apophysis elongated-pyramidal, narrowed into the compressed spiny-tipped straight or incurved umbo; seed-wing broadest about the middle and nearly 1 inch long. Southern and Lower California.—Introduced to Great Britain in 1847 by Hartweg. Hardy only in the Southern States. Tree of loose habit and with sparse foliage, but often picturesque in old age and the large cones are conspicuous and ornamental.

48. **P. Sabiniana,** Dougl. Digger P. (Bull P.). Tree to 50 or occasionally 80 feet tall, usually divided into several stems with short crooked branches, the lower ones pendent, the upper ones ascending, forming a round-topped head; bark thick, dark brown, deeply and irregularly fissured into thick

ridges covered with small appressed scales; branchlets stout, glaucous: leaves slender, flexible, pale bluish-green, 8–12 inches long: cones pendent on about 2-inch-long stalks, oblong-ovoid, light red-brown, 6–10 inches long; apophysis pyramidal, sharply keeled, narrowed into a stout, incurved, spiny hook, the lower scales much reflexed and armed with a spur-like incurved spine; seed ¾ inch long, its wing about half as long as seed. Western California.—Introduced to Great Britain in 1832 by D. Douglas. Hardy probably as far north as the Middle Atlantic States. Very distinct pine of loose habit and with sparse and long pale foliage. The seeds are edible.



95. Pinus Torreyana.

49. **P. Torreyana,** Carr. Torrey P. (Soledad P.). Fig. 95. Plate XLIII. Tree to 40 or under favorable conditions in cultivation to 90 feet tall, with spreading and sometimes ascending branches; bark deeply and irregularly fissured into broad flat ridges covered with appressed, light, red-brown scales; winter-buds conic-ovoid, pale brown, scales with appressed tips and white, fimbriate, interlaced margins; branchlets greenish or purplish, bloomy, glabrous: leaves rigid, dark green, 8–13 inches long: cones broadly ovoid, 4–6 inches long, chocolate-brown; apophysis low-pyramidal; umbo elongated and reflexed with short spiny tip; seeds ¾ inch long, with a short wing about half as long as the seed. Southern California.—A small tree of irregular habit, little known in cultivation.

PART III

CERTAIN BROAD-LEAVED EVERGREENS

CHAPTER VI

GENERAL ADVICE ON BROAD-LEAVED EVERGREENS

IN a class by themselves are the broad-leaved trees and shrubs that hold their green foliage while dormant. The numbers are many, particularly in mild climates. In the North, the number is limited, but these species are of great beauty and importance. Rhododendrons, kalmias, and hollies at once come to mind, with all the associations of winter greenery.

In this discussion only the most outstanding or significant broad-leaved evergreens can be considered. As success with many of them is largely a question of the proper soil, we may first consider the most recent findings in this interesting subject.

It may be said in passing that as to transplanting there are few special difficulties. The statements touching the removal of conifers apply for most of the species. The range of broad-leaved evergreens is very large, however, and there are likely to be special adaptations to consider. "Rhododendrons and kalmias I have found easy to transplant," writes George P. Brett, of experiences in Connecticut, "and I have met with very few losses—in rhododendrons less than one per cent and in kalmias, transplanted from their native state, less than two per cent—and these trees, when once established, will grow practically without care and produce their magnificent yield of flowers. I do not mean by this, of course, that they will not do better if they are properly cared for, but, thoroughly hardy, they can be left without care longer than most other things of the plant world which I know anything about. In transplanting these broad-leaved evergreens, the greatest danger lies in using a lime-impregnated soil. A leaf-mold from the woods or muck

from a peaty swamp is the best material to use, with an abundant winter mulch of forest leaves."

ACID SOILS FOR CERTAIN BROAD-LEAVED EVERGREENS.—Coville

In the course of a series of experiments with blueberry seedlings, 1906 to 1910, it was found that these plants require an acid soil.* The experiments have since been extended to many other plants and it has been shown conclusively that a very large number of species in ornamental horticulture have the same requirement. Lack of success with some of the most beautiful evergreens is due to failure to provide them with the acid soil they demand. This is true especially of rhododendrons and nearly all other evergreens of the heather family, such as mountain-laurel (*Kalmia latifolia*), trailing arbutus (*Epigæa repens*), and heather (*Calluna vulgaris*).

In nature, acid nourishment is provided by the accumulation, on the surface of the ground, of a layer of half-rotted leaves, twigs, and rootlets. Such an accumulation, when it occurs in a sphagnum bog, is called bog peat, or simply peat; on well-drained sandy or gravelly soils it is called upland peat. Under good conditions upland peat is laced into a tenacious mat, a few inches in thickness, by the roots of the ericaceous plants that accompany it, and this mat persists year after year, continually renewing itself through each year's leaf-fall and the penetration of new roots into the decaying mass. Upland peat is normally brown, but is often blackened by ground fires.

On limestone soils or on soils which for any reason have an alkaline chemical reaction, upland peat does not form. The lime and other alkaline substances in the soil greatly hasten the decomposition of the leaves. Each year's leaf-fall is de-

*"Experiments in Blueberry Culture," 1910, published as Bull. 193, Bur. Plant Industry, U. S. Dept. Agr., 100 pages of text, 18 plates, and 31 text figures.

composed, much of it passing in liquid form into the underlying soil, prior to the leaf-fall of the following year. Fully decomposed leaves form a true leaf-mold, black in color and neutral or alkaline in reaction, in which rhododendrons and other acid-soil plants will not grow.

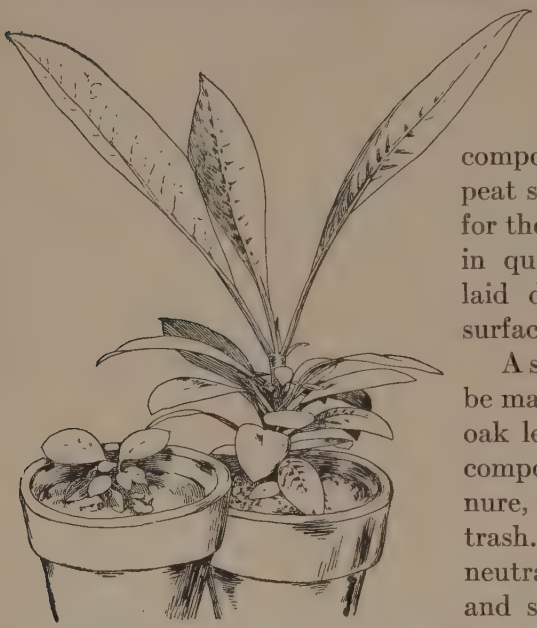
The continuation of acidity in upland peat is due to the arrest of decomposition before it has progressed to the alkaline stage, and the chief factor in the arrest is the lack of lime in the soil that underlies the leaves. When an upland peat mat is once established, its own acidity is fatal to the life of the organisms that as agents of rapid decay soon destroy its acidity.

In soils derived from granite, sandstone, sand, and gravel, acid conditions are usually maintained with little difficulty by the addition of upland peat, half-rotted oak leaves, or decayed wood or bark.

Sawdust and spent tanbark are acid materials useful as mulch for acid-soil evergreens. They should be applied experimentally at first, however, to test the safety and suitability of the particular kind that is available. Some kinds of sawdust, notably red cedar and pitch pine, contain, when fresh, substances that are directly injurious. Other sorts, such as basswood, maple, and birch, are free from them. In general, it is best to use sawdust that is weathered and partially decayed.

When an attempt is to be made to grow rhododendrons or other acid-soil evergreens in a place in which the soil is neutral or alkaline, such as a limestone soil, the bottomland of a river valley, the ordinary fertile garden, or a prairie or arid-region soil, it is necessary to prepare holes or trenches and make up a special soil mixture. This should consist of one part of clean sand to one or two, or even four, parts of upland peat or its equivalent. To keep earthworms from bringing up the underlying soil, the bottom of the hole should be lined with a two-

inch layer of soft-coal cinders. The depth of the peat and sand mixture need not be more than eight to twelve inches. A permanent mulch of oak leaves will help maintain a proper degree of moisture, and by decomposition will add to the peat supply. If the materials for the mixture are available in quantity, a bed may be laid down over the whole surface of the ground.



96. Injurious effect of ordinary rich garden soil on a rhododendron.—Half natural size

A sharp distinction should be made between half-rotted oak leaves and the ordinary compost of leaves with manure, garden soil, and garden trash. Such a compost is neutral or alkaline in reaction and should not be used on acid-soil plants. Sugar maple, elm, and linden leaves rot rapidly and so soon reach the alkaline stage that they are not desirable for acid-soil planting. Oak leaves, especially red oak leaves, rot slowly, and in two or three years, if the pile is turned over several times, make a good substitute for upland peat.*

No manure, lime, or wood-ashes should be applied to evergreens that require an acid soil, for all these substances tend to neutralize the necessary acidity. Cottonseed meal, ground soybeans, and spent malt, all of which contain a large amount of nitrogen in organic and acid form, are excellent fertilizers

*For a more extended discussion of the decay of leaves and its relation to acid soils, see "The formation of leafmold," Smithsonian Rept. for 1913, pages 333–343.

for acid-soil plants. In very sandy soils for which so little peat is available that the evergreens suffer for nourishment, the following special acid fertilizer devised for blueberries and cranberries would probably do well for rhododendrons, applied at the rate of an eighth to a fourth of a pound to a square yard.*

	Pounds
Nitrate of soda	17
Dried blood	23
Steamed bone	34
Phosphate rock	34
Potash	17

97. Beneficial effect of aluminum sulfate on Rhododendron maximum.—Half natural size

Experiments in the last two years have shown that an ordinary garden or greenhouse soil, well suited to roses, but fatal to rhododendrons, can be acidified by the application of crude aluminum sulfate, and will then nourish rhododendron seedlings almost as well as peat and sand (see Figs. 96, 97).†

*From page 20 of "Directions for blueberry culture, 1921," Bull. 974, U. S. Dept. Agr., 24 pages and 29 plates.

†For a detailed account of these experiments, see "The effect of aluminum sulphate on rhododendron seedlings," 1923, Bull. 1, Amer. Hort. Soc., 6 pages and 5 plates.

Fig. 96. *Injurious Effect of Ordinary Rich Garden Soil on a Rhododendron.* In early May, healthy seedlings of *Rhododendron maximum* were set in 2-inch pots in an ordinary greenhouse or fertile garden soil composed of equal parts, by bulk, of loam, well-rotted manure, and sand. Other exactly similar plants were potted in a soil consisting of two parts of peat to one of sand. In June of the following year, when the photograph was made, the plant at the left, in the ordinary fertile garden soil, had made no growth, while the plant at the right, in the strongly acid peat soil, had made normal and luxuriant growth.

Fig. 97. *Rhododendron maximum a Year after Treatment with Aluminum Sulfate.* The plant at the left (same as in Fig. 96), potted in a fertile garden mixture on May 3, 1921 which is not suited to rhododendron culture, had made no growth when it was photographed on June 3, 1922. The plant at the right, exactly similar to the other in history and treatment except that it had received one-third gram of aluminum sulfate in 10 cubic centimeters of water on May 27, 1921, made luxuriant growth, almost as good as the plant in the acid peat-and-sand soil illustrated in Fig. 96.

These experiments will be extended during the coming season to larger rhododendron and other acid-soil plants in the deeper soil of outdoor plantings. For such situations, it is believed, amounts of aluminum sulfate up to half a pound to a square yard may be applied advantageously and safely if the soil is of the ordinary fertile type, the application being repeated if the soil is not made acid by the first application. Outdoor experiments with aluminum sulfate should not be tried in mixed plantings unless it is known that all the plants are suited to a strongly acid soil, because the ordinary plants of horticulture, which thrive best in a neutral or alkaline situation, are likely to be severely injured, or killed, by the aluminum sulfate. For the present, the aluminum-sulfate treatment should be regarded as experimental. Those desiring to try it on sickly rhododendrons should apply it only to a portion of a planting, always leaving another part untreated for comparison.

Limestone water, which is alkaline in reaction, will ultimately injure an acid-soil planting. Rainwater or some other water that is neutral or even acid in reaction should be used if practicable. If only alkaline water is available for sprinkling purposes, it can be made neutral or slightly acid by dissolving in it a suitable amount of aluminum sulfate. The proper quantity can be determined by adding to a teaspoonful of the treated water in a white dish a fraction of a drop of the dye known as bromthymol blue. If the amount of aluminum sulfate added to the water is just sufficient to make it neutral, its color under this test will be green; if it has become acid, yellow; if it is still alkaline, blue.*

Evergreen species, like other plants, vary in the degree of soil acidity or alkalinity to which they are best adapted. The

*For an account of the method of determining the degree of soil acidity, see Edgar T. Wherry, 1922, "Soil acidity—its nature, measurement, and relation to plant distribution," Smithsonian Rept. for 1920, pages 247–268, with 1 plate and 1 color chart.

preparation of authentic lists of species on this basis will necessarily be a slow procedure, the outcome of careful experimentation, but fortunately a general though not infallible guide to the need of soil acidity for a particular species is already in existence in such well-known works on gardening as Nicholson's Illustrated Dictionary of Gardening and Bailey's Standard Cyclopedia of Horticulture. European gardeners have learned from long and cumulative experience that certain plants thrive best when supplied with peat, and this knowledge has been handed down to us in garden literature, and in garden practice when conducted intelligently, but never apparently with any suggestion that the essential quality of the peat is its acidity. The statement in any reliable work on gardening that a particular species requires peat may be taken as good evidence that this is an acid-soil plant. In very many cases, however, especially in American works, this evidence is lacking.

DISEASES AND INJURIES OF ORNAMENTAL BROAD-LEAVED EVERGREENS.—Dickson

Winter-injury.

In cold winters, broad-leaved evergreens may be more or less severely injured, especially when growing in exposed situations. The injury is very similar to the winter-killing of conifers and takes the form of a burning of the foliage and killing-back of the young branches. In severe cases the whole plant may be killed. The plants may appear normal until early in the spring when, under the influence of the warm winds, they turn brown within a few days. The Japanese holly (*Ilex crenata*) and rhododendrons, especially *R. maximum* and *R. catawbiense*, have shown themselves much less susceptible to this type of injury. The exact cause of the injury is not definitely known, but it is probable that it is partly due to

excessive transpiration when the roots are unable to absorb water freely, and partly due to direct killing of the tissues by low temperature.

Growth in the late fall should not be encouraged, in order that the tissues may have time to mature before severe frosts appear. The protection of the roots with a mulch when there is little snow would be advisable.

Fungous diseases of rhododendron.

Bud-rot is caused by the fungus *Sporocybe azaleæ*, Sacc. The bud-scales first become light brown in color and finally a dark brown, standing out in contrast with the healthy buds. The rot may also extend down the stem, killing it back for some distance. Later the fruit bodies of the fungus appear on the outside of the dead buds as small, dark-colored, hair-like projections, the tips of which are slightly swollen and consist of a mass of spores. For control, the removal of all diseased buds is recommended.

In leaf-blotch irregular dead areas appear on the leaves and sometimes the killing extends around the whole margin of the leaves. It is caused by the fungus *Coryneum rhododendri*, S., infection taking place through injuries such as those inflicted by aphids. A similar disease, caused by *Coryneum beijerinckii*, Oud., has also been reported upon leaves of cherry-laurel. When occurring abundantly, this blotch may cause defoliation. Several sprayings during the season with a 4–4–50 bordeaux mixture will probably hold the disease in check.

In leaf-spot the fungus *Pestalozzia guepini*, Desm., causes the death of small areas of the leaves, these areas becoming grayish in color. This fungus probably also follows the attack of aphids. Although no control measures have been recommended, spraying with bordeaux mixture might be tried.

In circular leaf-spot, small, more or less circular areas of the leaves are killed and upon these the fruit bodies of the fungus appear in concentric rings as tiny black dots. This disease, caused by Cryptostictis species is common in some regions on cultivated rhododendrons. Bordeaux mixture might also be tried in the case of this disease.

Shoe-string root-rot is caused by the fungus *Armillaria mellea*, Fries, which has already been described in connection with a similar disease of coniferous trees (see page 152). The black strands of fungous material grow through the soil and attack the roots, causing them to rot. This may result in the death of the shrubs. Sooner or later the typical fruiting bodies (toadstools) appear above the surface of the ground in the neighborhood of the roots. The disease has also been found upon azaleas.

As soon as this disease becomes evident in a shrubbery, the safest measures would be to sacrifice the affected plants. These should be dug up and burned immediately, taking care to remove as many of the roots as possible. A liberal amount of quicklime should then be applied to the soil from which the shrub was removed. No other shrub or tree should be planted in this spot for about three years, during which period the soil should be frequently turned over and exposed to the sun.

In order to prevent the spread of the disease to other plants in the shrubbery, a trench about two feet deep may be dug around the diseased area just beyond the limits of the roots, all soil removed being thrown inside the isolated zone. No roots should be allowed to cross this trench.

Diseases of kalmia.

Leaf-blight occurs on the mountain laurel (*Kalmia latifolia*), causing a blight or dry rot involving either large areas of the

leaf-blade or the entire leaf. Small, irregular, dark brown spots first, appear usually at the tip or round the margin of the leaf and these, when the air is moist and warm, gradually increase in size until the whole leaf is killed. Later the disease may spread down the petioles and into the stems, killing the whole plant. Badly infected leaves, petioles and stems become very dry and brittle and such leaves drop off rather easily. It is probable that the causal fungus (*Phomopsis kalmiæ*) gains entrance through wounds.

All diseased portions of the plant should be carefully removed and destroyed. This should include the cleaning up of all fallen leaves. The young growth may be protected by the use of bordeaux mixture.

Diseases of azalea.

The leaves of azalea and certain closely related plants are commonly attacked by species of Exobasidium which cause gall-like swellings. From Europe the disease has been reported on the cultivated *Azalea indica* and *A. pontica*. It has been recommended that all diseased parts should be cut out and destroyed and the young growth sprayed with bordeaux mixture or lime-sulfur.

Septoria leaf-spot also occurs upon *Azalea indica* and is caused by the fungus *Septoria azaleæ*. Small brown spots appear on the leaves and upon these the fruit-bodies of the fungus can be seen later as small black dots. No control has been suggested, but cleaning up the old leaves and the use of bordeaux mixture or lime-sulfur should prove satisfactory.

Diseases of cherry-laurel.

The same fungus (*Sphærotheca pannosa*, Lev.) which causes a mildew on the rose and peach has been found to attack the cherry-laurel (*Prunus Laurocerasus*). While not a serious

disease, it reduces somewhat the ornamental value of these shrubs in that it causes white patches upon the leaves and young shoots. The older leaves are not usually attacked and on those which are affected the spots generally disappear with age.

If troublesome, dry "flowers of sulfur" should be well dusted over the affected parts. This should be done on a still day, preferably during sunshine. The treatment should be repeated about every ten days until the fungus disappears.

THE LEADING BROAD-LEAVED EVERGREENS AND THEIR ADAPTATION.—Dunbar

Broad-leaved evergreens do not form an important or conspicuous feature in landscape-gardening throughout the northeastern or New England States. For broad distinctive effects coniferous evergreens must be depended on. Many broad-leaved evergreens that succeed very well in the Carolinas and adjacent States cannot be relied on in New England. Cold, searing, penetrating winds are very trying to most broad-leaved evergreens, and brown and scorch the foliage. The limited number suggested in the following notes mostly require to be more or less protected by the lay of the land or otherwise.

Amongst broad-leaved evergreens, rhododendrons unquestionably take the first place wherever conditions are at all propitious for their cultivation. General experience shows that rhododendrons will not thrive in soil that contains lime. If the soil indicates a specific alkalinity of three, and the subsoil is porous and naturally well drained, it is perfectly safe to remove the soil to a depth of two and one-half to three feet and replace with humus or peat enriched with cow-manure on the surface. This is exactly what has been done in the rhododendron valley in Highland Park, and it has been under ob-

servation for twenty-three years. However, if the soil shows a specific alkalinity of ten, it would be unwise to attempt to grow rhododendrons even by replacing the soil with humus or peat. Under such conditions the abundant circulation of underground water, strongly impregnated with lime, would render it unfit for rhododendron growth. When rhododendrons are planted in humus, they must be carefully watered, as humus or peat dries out more rapidly than ordinary soil. Protection from the sweep of cold winds by the lay of the land or otherwise is absolutely necessary. A partial protection from direct winter sunshine is advocated by many growers, but this is not necessary if they are in vigorous condition and have sufficient moisture at the roots and are heavily mulched with leaves in the autumn. In Durand-Eastman Park, Rochester, on the shore of Lake Ontario, where the soil is a light sandy loam and practically free from lime, the native American rhododendrons have been planted in moist naturally well-drained ravines without any preparation of the soil, other than digging and trenching, and they are growing and rooting freely and give every promise of success. A little mulching of rotted manure or leaves over the roots is about all the attention they secure.

The standard hardy *Rhododendron catawbiense* hybrids are the only ones adapted to the northeastern States, and many of them have rich pleasing colors. Amongst the species, *R. arbutifolium*, *brachycarpum*, *campanulatum*, *caucasicum* and var. *pictum*, *carolinianum*, *dahuricum*, *ferrugineum*, *hirsutum*, *maximum*, *Metternichii*, *minus*, *mucronulatum*, *myrtifolium*, and *Smirnowii* are all hardy under protective conditions described above. *R. arbutifolium*, *myrtifolium*, *ferrugineum*, and *hirsutum* brown considerably with the late winter's sun, and it is best to lay some evergreen branches over them. It is important to remove the faded flower-clusters.

The lace-fly has become a serious pest to rhododendrons in many parts of the country in recent years. The nymphs begin to feed on the under side of the leaves about the time they are through blooming, and the foliage soon presents a sickly appearance as if attacked by the mite known as red-spider. Fortunately, it is easily kept under control by two or three sprayings of ivory soap (any other standard soap, perhaps, is just as good for the purpose), using it in the proportion of five pounds of soap dissolved in one hundred gallons of water. Tobacco dust does not seem to destroy it.

The different species of Kalmia, *K. latifolia, K. angustifolia* and *K. polifolia*, need the same treatment as for rhododendrons. *Kalmia latifolia* is a most excellent decorative shrub and, when planted in masses, the effect in full bloom in the month of June is particularly pleasing. Judging from conditions in the wild, *K. polifolia* is not particular about the presence or absence of lime.

Pieris floribunda is a beautiful, hardy, ornamental shrub. It never browns in severe winters. The panicles of white flowers about May 1 are quite showy. It is particularly pleasing when grouped in front of rhododendrons. *Pieris floribunda* is not so much averse to the presence of lime as are rhododendrons. *Pieris japonica* is quite tender and in a severe winter is much injured. It is a beautiful dainty evergreen when it stands the winters.

Leucothoë Catesbæi is a very characteristic broad-leaved evergreen. The deep green leaves, four to seven inches long, are very handsome. It requires a moist soil in partly shaded conditions to be at its best. The white flower racemes are very attractive about the middle of May. This is an excellent shrub to use as ground-cover in moist situations under light shade, where lime is not present in the soil.

The leather-leaf, *Chamædaphne calyculata*, is a common, aquatic, native shrub. It often grows spontaneously with its roots and stems immersed in water. It does remarkably well, however, in ordinary soil of a peaty or leaf-soil composition. If given good attention it will assume a much better and denser appearance than in native conditions. The white blossoms are not conspicuous.

Andromeda glaucophylla is a neat, dwarf, low shrub, often growing in sphagnum swamps. When thickly massed together in front of rhododendrons, it makes a very effective low mat. The narrow pale green leaves, with the small clusters of pinkish flowers in June, are very attractive. This shrub will grow in sandy soil containing lime.

The bear-berry, *Arctostaphylos Uva-ursi*, is a dense evergreen creeping shrub with small deep green leaves, native throughout the northern hemisphere. It often covers the ground in large areas, and forms a dense evergreen carpet. Near Leroy, New York, the bear-berry grows in dense carpets on Onondago limestone rocks, with only two or three inches of soil, the roots clinging to the disintegrated limestone. Chemical tests indicated that the roots were growing in chert, in pockets over the limestone rocks, and that there was sufficient acidity in this for the roots not to be influenced by the near-by lime. It seems extraordinary that a supposed lime-hating plant should select such an environment and be in excellent health.

The Scotch heather, *Calluna vulgaris*, may be grown in the North in a number of varieties. The var. *alba* is very attractive in bloom in July and August. *Erica carnea* and *E. vagans* are the best two enduring heaths. The heather and the heaths require soils of a peaty nature.

The American holly, *Ilex opaca*, is a most important evergreen shrub or small tree for the northeastern States. It stands

through the severest winters, and while it occasionally browns and loses some leaves, it always recovers. It requires good, rich, moist, sandy loam and should be planted in a situation protected from the sweep of the prevailing cold winds. The inkberry, *Ilex glabra*, native from New Jersey to Florida, is an excellent evergreen shrub. The deep leaves never appear to brown in the severest winters. It requires a very moist well-drained soil to be at its best. The Japanese holly, *Ilex crenata*, in several forms, is a very neat evergreen shrub, with small leaves. In a severe winter it suffers considerably in western New York. It should be planted in a well-protected situation, and it is wise to place a few evergreen branches over it.

Mahonia Aquifolium has beautiful lustrous holly-like foliage and is quite hardy. The foliage browns in winter considerably, and it should be planted so that it will be protected from the winter's sun. Seedlings of *M. Aquifolium* vary considerably in habit and hardihood, some forms withstanding the burning injury of the winter's sun remarkably well. *Mahonia repens* is a low-growing species and spreads freely by stolons. It hardly ever browns, and is quite hardy. *Mahonia pinnata* is fairly hardy, but needs protection, as it is subject to considerable injury in a severe winter. *Mahonia japonica* must be planted in a well-protected situation, as it is likely to suffer even in an ordinary winter.

Amongst the evergreen barberries, some of the recent introductions from China are very promising. *Berberis verruculosa* is a beautiful compact form with lustrous deep green leaves and conspicuous long spines. It suffered considerably during the winter of 1917 and 1918. In an ordinary winter it is very satisfactory. *Berberis Sargentiana* has thick, deep green, rather spiny leaves and has about the same hardihood as *B. verruculosa*. Another new Chinese species that is proving very

satisfactory is *Berberis Gagnepainii*. It has narrow, tapering, wedge-shaped leaves and is very distinct in its habit of growth. *Berberis stenophylla* is a beautiful old garden hybrid with small deep green leaves and handsome yellow flowers, but needs close protection in winter. *Berberis buxifolia*, from the Strait of Magellan, has been long in cultivation and has small, elliptic, deep green leaves. It needs about the same protection as *B. stenophylla*.

Cotoneaster horizontalis, native of China, has horizontal branches with roundish deep green leaves. The bright red fruits are very attractive in September. This is a most excellent shrub in rock-gardening. Var. *perpusilla* has smaller leaves than the type. It is a very pretty ornamental form and, like the former, is well adapted to rock-gardening. *Cotoneaster Dammeri*, from China, has a prostrate habit with the leaves arranged as if in two ranks. It is well adapted for clinging to low slopes or creeping over edges of rocks. *Cotoneaster adpressa* is a dainty low species which forms a low dense mat and is admirably suited to rock-gardening. *Cotoneaster microphylla* has long been known in cultivation. It has a prostrate habit and the small, roundish, deep green leaves are very attractive. The bright red fruits in the autumn are showy. *Cotoneaster rotundifolia*, with prostrate branches and dark green oval leaves, is very ornamental. *Cotoneaster salicifolia* retains its leaves for the greater part of the winter. The habit is decumbent. The leaves are lance-shaped or ovate and densely woolly beneath. Var. *rugosa* has a more vigorous habit and the leaves are larger. The leaves are retained in good condition until March. It is a wise precaution to lay evergreen branches over these cotoneasters in winter, for when fully exposed to the winter's sun they are likely to be more or less browned.

The box-tree is a most important evergreen when it stands

the winter. It needs protection from the sweep of cold winds. In Highland Park several varieties have been grown for many years on a south slope in well-drained light soil. The different varieties of *Buxus sempervirens* are not well understood. The var. *Handworthii* has an upright bushy habit with deep green large leaves and is an unusually good form. Var. *angustifolia* has narrow leaves with an upright loose habit, and is very distinct. Var. *naviculariis* was introduced from Europe thirty years ago; it has a very upright habit with narrowly elliptic leaves, yellowish-green underneath. The common type form is a loose habited bush with roundish-oval leaves, convex on the upper surface. The different forms of the common box suffered considerably in the winter of 1917 and 1918, but in ordinary seasons they stand the cold very well. The Japanese box, *B. microphylla* var. *japonica*, is very hardy. It forms a spreading bush with light green lustrous leaves, and is a very desirable evergreen.

Henry's honeysuckle, *Lonicera Henryi*, is a climbing vine introduced recently from China. The lance-shaped deep green leaves, two to three inches long, present a very pleasing effect when spreading over the ground. When fully exposed to the winter's sun, the foliage is only partially evergreen. When covered with snow all winter, the leaves appear green and fresh in March. This is an excellent plant for slopes and banks. *Lonicera pileata*, from western China, is a low prostrate shrub with small oval leaves. It is quite hardy and well adapted to rock-gardening. It retains the leaves remarkably well throughout the winter.

Viburnum rhytidophyllum, native of western China, is a very bold handsome shrub. The large oblong deep green leaves, markedly covered with a grayish-green tomentum underneath, are very distinctive. In an ordinary or average winter, the

foliage is retained remarkably well. It is a wise precaution to plant it in a well-protected situation and partially protected from the winter's sun.

Amongst the euonymuses there are a number of evergreen forms, but *E. radicans* in several varieties is the only species that is dependably evergreen in the Northeast. The type form is most useful in front of low walls and will attain a considerable height in time. Var. *vegeta*, with much larger oval leaves, is perhaps one of the best evergreen vines. It has been called the evergreen bitter-sweet. It is very desirable in connection with any building where a low evergreen vine is desired with good effect at the base of masonry. The abundant fruits remain on the branches a long time and produce a beautiful effect in contrast with the leaves.

Daphne Cneorum, native of the mountains of central Europe, is a most beautiful, low, evergreen, hardy shrub and always a favorite. The pink blossoms nestling amongst the green leaves in the month of May are very attractive. In some localities it grows luxuriantly and in others it does not show the same vigor, even when conditions appear the same. For rock-gardening and in front of other choice evergreens, it is well adapted. *Daphne Blagayana*, native of southeast Europe, is a very rare, dainty, evergreen plant, and is quite hardy. The yellowish-white flowers are delicately fragrant.

The rock-rose, *Helianthemum Chamæcistus*, native of Europe and western Asia, is a trailing subshrub with small ovate green leaves. It is perfectly hardy and is excellent for rock-gardening. The type has yellow fleeting flowers, but there are numerous varieties with blossoms in various colors.

The wax-myrtle, *Myrica cerifera*, native from Maryland to Florida, does fairly well planted on a south slope in warm well-drained soil in an ordinary winter. The tapering leaves,

two to three inches long, retain their green verdure remarkably well until March. It suffered considerable injury in the winter of 1917 and 1918, but fully recovered.

Pachistima Canbyi, native in the mountains of Virginia, is a remarkably dainty low evergreen shrub, and where it thrives, forms a dense evergreen carpet. It is an excellent plant in rock-gardening. *P. Myrsinites*, native from British Columbia to New Mexico, has very dark green leaves and attains a height of one foot or more. It appears to be fairly hardy, but is capricious about exact soil conditions.

Akebia quinata, a very hardy handsome vine from Japan, cannot be considered a dependable evergreen. When trailing on the ground and covered with snow, when the snow disappears, in the month of March, the leaves will be perfectly green. When on a trellis fully exposed to sun and wind, the leaves will be browned and mostly dropped by February or March.

Yucca flaccida and *Y. filamentosa*, with long strap-shaped leaves, retain a pleasing green color throughout the entire year. Yuccas are not particular about soil conditions. They grow vigorously in light well-drained soil. A large group of these yuccas planted thirty years ago are now in excellent condition. *Yucca glauca*, with narrow light gray-green leaves, is quite hardy and stands the winter well.

Pachysandra terminalis is an excellent subshrubby plant for ground-cover. It forms a dense mat in time and the deep green glossy foliage is very pleasing. It seems to do equally well in sun or shade.

The common periwinkle, *Vinca minor*, is frequently used as a ground-cover in deep shade. It has an agreeable green color and in time will densely cover the ground to the exclusion of all other plants. It will form a green carpet in the dense shade of coniferous evergreens.

BROAD-LEAVED EVERGREEN SHRUBS FOR THE MIDDLE WEST.—Bollinger

This distinct group of ornamental species is indispensable, not only for their foliage and flower effect in the summer, but also for their evergreen character. None is strictly hardy in the North and Northwest, yet with a little care and patience a few can be grown in well-protected sections.

Mahonia Aquifolium is a native evergreen shrub about two to three feet high, with shining prickly leaves of a deep bronze-green color. The bright yellow flowers in May are succeeded by small blue berries. It is propagated from seeds or hardwood cuttings. *Mahonia Bealii* is a small-sized shrub growing to the height of about two to three feet. It succeeds well in shady locations. This species requires protection in winter and should be planted in sandy loam with perfect drainage.

Berberis ilicifolia is an erect shrub about four feet high with prickly leaves, yellow blossoms in spring, followed by blue berries in fall.

Cotoneaster buxifolia is a low-growing evergreen shrub with oval box-like foliage. The white flowers appear in May and are followed by showy crimson fruits, which hang on all winter, giving it an attractive appearance. For winter effect it is one of the best. *Cotoneaster microphylla* is a low prostrate shrub densely branched. The leaves are small, shining above, and pubescent beneath. Flowers are inconspicuous, followed by red berries. Both varieties are perfectly hardy in the Northwest and are propagated from seeds. They like a moist clay loam.

Leucothoë Catesbæi is much planted in shady situations. The shining dark green leaves color in brilliant shades of bronze in the autumn. In the spring it bears small, white, wax-like flowers, delicate and fragrant. It grows three to four feet high. It thrives in clay loam and is propagated by root-cuttings.

Ilex opaca, American holly, has light green foliage and white flowers, followed by dull red berries late in fall. It is much used for decoration at Christmas. It does well in the shade and prefers moist soil.

Euonymus radicans is a low procumbent shrub with often trailing and rooting or climbing branches, sometimes to a height of fifteen to twenty feet. The foliage is dull green above with whitish veins. The fruit is light red. It is desirable for covering rocky banks or rough walls. There is a form with foliage variegated creamy white and light rose. In autumn it turns to a shade of purplish-pink. Both varieties like a moist soil and are propagated from seeds and green wood cuttings. Var. *Carrierei* is a large, handsome, glossy-leaved climber, useful for covering stone walls, buildings, and for ground-cover, but must be protected from the winter sun. It is not quite hardy in the Northwest and must be planted in moist but perfectly drained soil. It will do best on an eastern and southern exposure. Var. *vegeta* is a broad-leaved creeper valuable for ground-cover, being a strong grower with handsome green foliage followed by abundant fruit. It requires protection from the winter sun and will do well in partial shade. Var. *acuta* is distinguished by its sharp-pointed leaves. It grows rapidly and is hardy; valuable for ground-covering, walls, and buildings.

Pachysandra terminalis, or Japanese spurge, is one of the best ground-covers and the one principally used in the Northwest on account of its hardiness and ease of propagation. It is useful for bordering walks and drives under evergreen and shrub plantings and does well in some shade or even in dense shade where grass will not grow. The leaves are green all winter. It grows from six to nine inches high and spreads along the ground and does not require protection. It is propagated from cuttings and grows best in a clay loam.

Buxus sempervirens, the old-fashioned type, is the only box worth growing in the Middle West. The cold weather is not injurious, but the thawing and freezing of soil and the winter sun on the foliage are often damaging. It requires a moist, rich, sandy loam and perfect drainage. It is valuable for edging formal flower-gardens, but only where it can be protected easily in winter with evergreen branches or light boards. The Japanese varieties are not hardy in the Middle West or Northwest.

Native rhododendrons usually do fairly well for two or three years, when they will succumb. This is probably due to improper soil conditions.

CHAPTER VII

THE MAIN BOTANICAL KINDS OF BROAD-LEAVED EVERGREENS.—Rehder

AS STATED in the introductory remarks to the fifth chapter, in the northern latitudes one must rely for evergreen plantations chiefly on conifers which are the only woody plants able to grow there to real tree-size. The number of broad-leaved evergreens which attain to the size of trees in these regions is very limited and, moreover, they are slow in growing even to a small size. Broad-leaved evergreens are essentially inhabitants of warmer climates; in the tropical and subtropical zones they are usually the chief components of the forests, at least in those parts in which sufficient humidity makes possible the existence of real forests. Toward the north, the broad-leaved evergreens gradually diminish in number as well as in size, and in the northeastern States the only tree-like broad-leaved evergreen is the holly, *Ilex opaca*, which reaches its northern limit in Massachusetts, and perhaps *Rhododendron maximum* and *Kalmia latifolia* may be added, although usually they attain only the size of a large shrub; the range of these extends somewhat farther north, to Nova Scotia and southern Ontario. Even if cultivated trees of foreign origin are considered, none can be found that is hardier or as hardy as *Ilex opaca*, and the only ones worth mentioning as growing into small trees under favorable conditions are, perhaps, *Buxus sempervirens*, *Ilex pedunculosa*, and *I. crenata;* however, these are apparently not reliable north of southern New York. The number of larger shrubs, those growing to the height of about five feet or more, is not large for the

region under consideration and only a number of Rhododendrons, a few species of Pieris, Leucothoë, Berberis, Mahonia, *Buxus microphylla* var. *japonica*, and *Osmanthus Aquifolium* can be mentioned.

On the Pacific Coast, with its more humid climate, cooler summers and milder winters, the belt of the evergreen trees extends much farther north, up to the fifty-first degree of northern latitude; besides the native *Arbutus Menziesii*, several foreign trees and large shrubs can be grown as far north and possibly even farther.

KEY TO THE LARGER BROAD-LEAVED EVERGREENS

A. Arrangement of leaves opposite.
  B. Branchlets slender, 4-angled: leaves entire, obtuse.
    C. Leaves broadest below or about the middle: branchlets usually pubescent ..... *Buxus sempervirens*, 362
    CC. Leaves broadest above the middle: branchlets usually glabrous ..... *Buxus microphylla*, 363
  BB. Branchlets stout, subterete: leaves spiny-toothed, rarely entire, pointed ..... *Osmanthus Aquifolium*, [371
AA. Arrangement of leaves alternate.
  B. Leaves pinnate: flowers yellow, in fascicled racemes at end of the branches.
    C. Leaflets 5–9, lustrous above ..... *Mahonia Aquifolium*, 361
    CC. Leaflets 9–15, dull above ..... *Mahonia Bealii*, 362
  BB. Leaves simple.
    C. Branches with usually 3-parted spines: leaves spiny-serrate: flowers yellow, in axillary clusters: fruits bluish-black.
      D. Leaf rather thin, indistinctly veined beneath, revolute at the margin, usually about ½ inch broad .. *Berberis Gagnepainii*, 360
      DD. Leaf thick and firm, usually broader than ½ inch.
        E. Young branchlets yellowish and slightly angled: leaves slightly reticulate beneath, to 2½ inches long ..... *Berberis Julianæ*, 361
        EE. Young branchlets reddish and terete: leaves distinctly reticulate beneath, to 4 inches long .. *Berberis Sargentiana*, 361
    CC. Branches not spiny.
      D. Margin of leaves serrate, crenate or spiny-toothed.
        E. All leaves spiny-toothed, rarely entire: fruit a red berry: usually a tree.
          F. Flowers and fruits on the young wood: leaves dull above ..... *Ilex opaca*, 364
          FF. Flowers and fruits on last year's branchlets: leaves lustrous above ..... *Ilex Aquifolium*, 363

EE. All leaves crenate to serrulate.
F. Branchlets and petioles with strigose brown hairs: leaves serrulate, acute: flower-buds during the winter in naked terminal panicles: fruit a capsule ..... *Pieris floribunda*, 370
FF. Branchlets and petioles glabrous or puberulous.
G. Leaf acute or acutish, 1½–2 inches long: fruit a black berry: flowers solitary or in small cymes.
H. Leaves with few shallow teeth near apex, the midrib elevated above; petiole about ¼ inch long ..... *Ilex glabra*, 365
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H. Flower-buds during the winter in naked terminal panicles: leaves narrow-cuneate at base, 1½–2½ inches long: upright shrub ..... *Pieris japonica*, 370
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II. Leaves long-acuminate, 4–7 inches long ..... *Leucothoë Catesbæi*, 369
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E. Terminal winter-buds small or wanting, consisting of few sub-equal scales: leaves glabrous even when young.
F. All leaves rounded or sometimes broadly cuneate at base: flowers axillary, small: fruit a red berry ..... *Ilex pedunculosa*, 364
FF. All leaves cuneate at base, crowded toward the end of the branchlets: flowers in terminal panicles, naked during the winter: fruit a capsule ..... *Kalmia latifolia*, 368
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F. Under surface of leaves scaly-punctate.
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FF. Under surface of leaves glabrous or tomentose.
G. Leaf tomentose beneath.
H. Base of leaves cuneate.
I. Petioles and branchlets covered with white or brownish woolly tomentum: leaves woolly-tomentose beneath . . . *Rhododendron Smirnovii,* [366
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H. Leaves usually obtuse or obtusish at the ends, 3–5 inches long, glabrous . . . . . *Rhododendron catawbiense,* 367
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BERBERIDACEÆ. BARBERRY FAMILY

BERBERIS, L. BARBERRY

Evergreen or deciduous shrubs, rarely small trees, with spiny branches; inner bark and wood yellow: leaves alternate, simple, entire or toothed; those of the shoots usually changed to mostly 3-parted spines, the normal leaves in clusters on short axillary spurs: flowers perfect, yellow, in elongated, umbel-like or compound racemes, or solitary or fascicled; sepals petaloid, with 2 or 3 bractlets at base; petals 6, often smaller than the sepals and usually with 2 nectariferous glands inside at base; stamens 6, irritable; anthers opening with 2 valves; ovary with 1 to many ovules; stigma sessile or on a short style: fruit a 1- to several-seeded, red, bluish, or black berry. (Name of Arabian origin.)—About 175 species chiefly in the temperate regions of the northern hemisphere and in South America, few in North America, Europe, and in the Mediterranean region.

The three following closely related species are the hardiest of the taller evergreen barberries in cultivation; in the neighborhood of Boston they are tender and survive only the milder winters with little or no injury; usually they are more or less killed back, even if protected. *Berberis Sargentiana* is the handsomest in foliage but tenderer than the other two.

B. Gagnepainii, Schneid. Evergreen shrub to 6 feet tall; branchlets terete, slightly verruculose, yellowish-gray; spines slender, 3-parted, $\frac{1}{2}$–$\frac{4}{5}$ inch long: leaves narrow-lanceolate, $1\frac{1}{2}$–4 inches long, sinuately spiny-serrate, with revolute margin, light green beneath and indistinctly veined, thinly coriaceous: flowers in fascicles of 3–10, about $\frac{1}{2}$ inch across, bright

yellow; pedicels ½–1 inch long: fruit ovoid, ⅓–⅔ inch long, bluish-black, bloomy, with nearly sessile stigma. Flowers in June; fruit in autumn. Western China.—Introduced in 1904 by E. H. Wilson to England and in 1908 to the Arnold Arboretum.

B. Julianæ, Schneid. Evergreen shrub to 6 feet tall; branchlets slightly angled, yellowish when young, light yellowish-gray or yellowish-brown the second year; spines rigid, 3-parted, ½–1¼ inches long: leaves narrow-elliptic to lanceolate or oblanceolate, 1½–2½ inches long, spiny-serrate, dark green above, light green beneath and indistinctly veined, coriaceous: flowers fascicled; pedicels ½–1 inch long: fruit ovoid-oblong, about ⅓ inch long, bluish-black, bloomy, with a short but distinct style. Central China.—Introduced in 1900 by E. H. Wilson to England and in 1907 to the Arnold Arboretum.

B. Sargentiana, Schneid. Evergreen shrub to 6 feet tall; branchlets terete, reddish while young, yellowish-gray or grayish-brown the second year; spines rigid, 3-parted, ½–1¼ inches long: leaves elliptic-oblong or oblong to oblong-lanceolate, 1½–4 inches long, rather closely spiny-serrate, dark green above, light green beneath and slightly reticulate, coriaceous: flowers about ½ inch across, fascicled; pedicels ½–1 inch long: fruit ovoid, ¼–⅓ inch long, bluish-black, slightly bloomy; stigma sessile. Central China.—Introduced in 1907 by E. H. Wilson to the Arnold Arboretum. This is the handsomest of the three species here described.

MAHONIA, Nutt. MAHONIA

Evergreen unarmed shrubs, rarely small trees; terminal bud pointed, with numerous persistent scales: leaves alternate, odd-pinnate, rarely 3-foliolate; leaflets usually spiny-dentate, the lateral ones sessile: flowers yellow, in usually many-flowered racemes or panicles springing from the axils of bud-scales; sepals 9; petals 6; ovary usually with few ovules; stigma sessile or on a short style: fruit dark blue and bloomy, rarely red or whitish; seeds few to many. (Named in honor of Bernard M'Mahon, a prominent American horticulturist; 1775–1816.)—About 50 species in North and Central America and in eastern and southern Asia.

M. Aquifolium, Nutt. (*Berberis Aquifolium*, Pursh. *Odostemon nutkanus*, Rydb.). Upright shrub to 3 or rarely 6 feet tall: leaflets 5–9, ovate to oblong-ovate, 1½–3 inches long, rounded or truncate at the base, sinuately spiny-dentate, lustrous dark green above, rarely dull, glaucescent and papillose beneath, stiff and leathery; petioles slender, ¾–2 inches long: racemes fascicled, erect, 2–3 inches long, at the end of the branchlets: fruit subglobose, about ⅓ inch across, bluish-black, bloomy. Flowers in May; fruit in autumn. British Columbia to Oregon.—Introduced about 1806 by the Lewis and Clark Expedition and first cultivated by M'Mahon in Philadelphia.

A supposed hybrid between this species and the tenderer *M. pinnata*, Fedde, is **M. Wagneri,** Rehd. (*M. pinnata* var. *Wagneri*, Jouin), with 7–11-foliolate leaflets and short petioles; it grows taller than the preceding species, but is apparently not yet in cultivation in this country.

M. Bealii, Carr. (*M. japonica* var. *Bealii*, Fedde. *Berberis Bealii*, Fort.). Shrub to 15 feet tall, with stout upright stems: leaves about 1 foot long; leaflets 9–15, roundish-ovate to ovate-oblong, 2–5 inches long, with 2–5 large spiny teeth on each side, the lateral ones very oblique at base, the lowest pair much smaller and close to the base of the petiole, the terminal leaflet stalked, truncate or subcordate at base, larger than the others, dull dark bluish-green above, glaucescent beneath, rigidly coriaceous: flowers lemon-yellow, fragrant, crowded, in fascicled upright and stout racemes 3–6 inches long, on pedicels about $\frac{1}{5}$ inch long: fruit bluish-black. Flowers in May: fruit in autumn. China.—Introduced by Fortune in 1845 to Great Britain. It stands ordinary winters in the neighborhood of Boston, but is more or less injured or killed back in severe winters. A desirable shrub on account of its bold striking foliage and the large clusters of fragrant flowers. Often cultivated under the name *M. japonica* or *Berberis japonica*, but the true *M. japonica*, DC., appears not to be in cultivation in this country.

BUXACEÆ. BOX FAMILY

BUXUS, L. BOX

Evergreen shrubs or trees; winter-buds with several outer scales: leaves opposite, short-petioled, penninerved, entire, coriaceous, usually glabrous: flowers apetalous, in axillary and terminal clusters consisting usually of a terminal pistillate flower and several lateral staminate flowers; the latter with 4 sepals and 4 stamens exceeding the sepals and a rudimentary pistil; pistillate flowers with 6 sepals and a 3-celled ovary with 3 short styles: fruit a subglobose or obovoid 3-horned capsule separating into 3 2-horned valves, each with 2 lustrous black seeds. (Ancient Latin name of the box-tree.)—About 30 species in the Mediterranean region, eastern Asia and the West Indies and Central America.

B. sempervirens, L. Much-branched dense shrub or small tree to 15, rarely to 30 feet tall; branchlets quadrangular, puberulous: leaves elliptic or ovate to oblong, ½–1½ inches long, obtuse or emarginate at apex, dark green above, light or yellowish-green beneath, lustrous on both sides; petiole usually puberulous: flowers in axillary clusters; staminate flowers sessile; the rudimentary pistil half as long as the calyx: fruit about ⅓ inch long. Flowers in spring; fruit in autumn. Southern Europe, North Africa, and western Asia.—Cultivated since ancient times in Europe and early introduced into

this country. Hardy in sheltered localities as far north as eastern Massachusetts.

The typical tall-growing form is usually distinguished as var. **arborescens,** L.; its leaves are usually elliptic and about 1 inch long. A number of garden forms are in cultivation of which perhaps var. **rotundifolia,** Baill., with broadly oval leaves, and var. **myrtifolia,** Sweet, with smaller elliptic-oblong leaves are most often cultivated; these, like the other forms, remain usually lower than the type.

B. microphylla var. **japonica,** Rehd. & Wils. (*B. japonica,* Muell. Arg. *B. sempervirens* var. *japonica,* Makino. *B. obcordata,* Hort.). Shrub to 6 feet tall with spreading branches; branchlets sharply quadrangular, glabrous: leaves obovate to orbicular-obovate, rounded or emarginate at apex, cuneate at base, ½–1½ inches long, bright green; petioles glabrous: flowers in axillary clusters; the rudimentary pistil of the staminate flowers about as long as the calyx. Flowers in spring; fruit in autumn. Japan.—Introduced probably about 1860 by Siebold to Europe and in 1892 by Prof. C. S. Sargent to the Arnold Arboretum where it has proved perfectly hardy. It is a shrub of looser more spreading habit with lighter colored foliage than the common box.

The typical **B. microphylla,** Sieb. & Zucc., from Japan, is a much lower shrub not exceeding 3 feet in height and sometimes prostrate, with leaves ⅓–1 inch long and the flower-clusters mostly terminal. The variety **sinica,** Rehd. & Wils., from China, differs in its puberulous branchlets and petioles and attains a height of 8 feet. It was introduced in 1900 by E. H. Wilson to England and later to this country, but did not prove hardy at the Arnold Arboretum.

AQUIFOLIACEÆ. HOLLY FAMILY

ILEX, L. HOLLY

Evergreen or deciduous shrubs or trees; winter-buds small with about 3 outer scales: leaves petioled, entire or toothed, often with spiny teeth; stipules minute, deciduous: flowers diœcious or polygamous, axillary, solitary, fascicled or in cymes, small, white or greenish-white, usually 4-merous, or 5–8-merous; stamens 4–5; disk wanting; ovary superior, 3–many-celled, each cell with 1 or 2 pendulous ovules; stigma subsessile: fruit a berry-like drupe with 2–8 bony 1-seeded nutlets. (Ancient Latin name of *Quercus Ilex* transferred to this genus.)—About 300 species in the temperate and tropical regions of both hemispheres.

I. Aquifolium, L. English Holly. Tree to 40 or occasionally to 70 feet tall, with short spreading branches forming usually a pyramidal or oblong head, glabrous or the young branchlets minutely puberulous: leaves short-petioled, ovate or elliptic to oblong-ovate, 1½–3 inches long, margin wavy

with large triangular spiny teeth, on old trees partly or mostly entire, lustrous above and dark green, yellowish-green beneath: flowers in axillary clusters on branchlets of the previous season, white, fragrant, short-stalked: fruit globose, about ⅓ inch across, bright red, usually clustered, on stalks ⅙–¼ inch long. Flowers in May and June; fruit late in autumn remaining through the winter. Western and southern Europe, north Africa, and western Asia to China.—Cultivated since ancient times in Europe and early introduced into this country. It is less hardy than the American holly but can be grown in sheltered locations from New Jersey southward. It is much planted in England where a large number of garden forms have originated, chiefly differing in size, shape, and color of the leaves.

I. opaca, Ait. American Holly. Plate XLIV. Tree to 40 feet tall, with short spreading branches forming a narrow pyramidal head, glabrous except the young finely puberulous branchlets: leaves elliptic to elliptic-lanceolate, 2–4 inches long, with large, remote, spiny teeth, rarely nearly entire (f. *subintegra*, Weatherby), dull green above, yellowish-green beneath; petiole ¼–½ inch long: flowers on the young branchlets in the axils of the leaves or of scales near the base of the branchlets; staminate flowers in 3–9-flowered stalked cymes, the pistillate usually solitary: fruit globose, about ¼ inch across, usually solitary, red, rarely yellow (f. *xanthocarpa*, Rehd.). Flowers in May and June; fruit late in autumn through the winter. Massachusetts to Florida west to Missouri and Texas.—Introduced to England in 1741. It is not hardy north of its range and in cultivation it is usually a dense pyramidal tree of slow growth not easily transplanted when older. The berried branches are extensively gathered for Christmas decoration which has caused the mutilation and gradual disappearance of this tree from many localities in which it was formerly plentiful.

I. pedunculosa, Miq. Shrub or small tree to 30 feet tall; branchlets glabrous: leaves ovate or elliptic, 1½–3 inches long, acuminate, rounded or broadly cuneate at base, entire, lustrous and bright green above; petiole ½–¾ inch long: flowers in slender-peduncled cymes axillary on the young branchlets: fruit subglobose, about ¼ inch thick, bright red, on slender pedicels ½–¾ inch long, solitary or several on a slender drooping peduncle ¾–1½ inches long. Japan.—Introduced in 1892 by Prof. C. S. Sargent to the Arnold Arboretum where it has proved hardy with slight protection. The Chinese var. **continentalis,** Loes., with the leaves remotely appressed-serrulate above the middle, is tenderer.

I. crenata, Thunb. (*I. Fortunei*, Hort.). Much-branched shrub, rarely small tree to 20 feet tall; young branchlets minutely puberulous, terete: leaves crowded, short-stalked, elliptic or obovate to oblong-lanceolate, ½–1¼ inches long, acute, cuneate or broadly cuneate at base, crenate-serrate or serrulate, lustrous dark green above, glabrous: flowers 4-merous, axillary

on the young branchlets, the staminate in 3–7-flowered cymes, the pistillate solitary: fruits globose, about ¼ inch thick, black, on stalks 1/6–¼ inch long. Flowers in May and June; fruits ripening in October and remaining during the winter. Japan.—Introduced to Europe in 1864, to America in 1875 by Thomas Hogg. Hardy in southern New York and southward. The var. **microphylla,** Maxim., with smaller elliptic to elliptic-oblong leaves ⅛–⅗ inch long is hardier and stands the average winter at the Arnold Arboretum, but in severe winters it is more or less injured.

A shrub of similar appearance is **I. yunnanensis,** Franch., from western China, but it has red fruit, ovate to ovate-oblong leaves, and pubescent branchlets. The var. **gentilis,** Loes., differs chiefly in its glabrous branchlets.—Introduced in 1911 from central China by E. H. Wilson to the Arnold Arboretum, where it has proved fairly hardy in sheltered positions. It will be a desirable addition to the evergreen shrubs and is superior to *Ilex crenata* on account of the showier fruit, but it is not yet in the trade.

I. glabra, Gray (*Prinos glaber*, L.). Inkberry. Winterberry. Shrub to 6 or 7 feet tall with upright slender branches; young branchlets puberulous: leaves obovate to oblanceolate, acute to obtusish, cuneate at base, ¾–2 inches long, with a few shallow obtuse teeth near the apex or occasionally entire, dark green and lustrous above, light green beneath, glabrous: flowers axillary on the young branchlets, the staminate in several-flowered cymes on slender peduncles, the pistillate ones often solitary, 5–8-merous: fruit globose, ¼ inch across, black, short-stalked. Flowers in June; fruits late in autumn and remaining during the winter. Nova Scotia to Florida, and Louisiana, near the coast.—Introduced in 1759 to Great Britain. Hardy as far north as New England and southern Ontario.

ERICACEÆ. HEATH FAMILY

RHODODENDRON, L. (Plates XLV–XLVII)

Evergreen or deciduous shrubs, rarely trees; winter-buds scaly, usually large and conspicuous: leaves alternate, short-petioled, entire, exstipulate: flowers pediceled, in terminal umbel-like racemes, rarely lateral, sometimes in few-flowered clusters or solitary; calyx 5-parted, often very small; corolla rotate, campanulate or funnel-shaped, sometimes tubular, with 5- or sometimes 6–10-lobed limb; stamens 5–10, or sometimes more; anthers opening with pores at the apex; ovary 5-celled, or sometimes 6–10-celled; style slender, with capitate stigma: fruit a capsule separating into 5–10 valves; seeds numerous, small. (Name derived from Greek *rhodon*, rose, and *dendron*, tree, but the rhododendron of the ancient Greek was Nerium.)—About 400 species, chiefly in the temperate regions of the northern hemisphere, also on the

higher mountains of southern Asia and the islands of the Malayan Archipelago extending to Australia.

R. minus, Michx. (*R. punctatum*, Andr. *R. Cuthbertii*, Small). Straggling shrub to 10 feet tall: leaves elliptic to elliptic-lanceolate, acute at the ends, sometimes acuminate at the apex, 1½–4 inches long, glabrous above, glandular-lepidote beneath: flowers in 6–8-flowered clusters; calyx short; corolla funnelform-campanulate, about 1 inch across, rosy-pink, the upper lobe spotted greenish, lepidote outside; tube nearly cylindric, longer than the ovate crisped lobes. Flowers in June and July with or usually after the young leaves. North Carolina to Georgia and Alabama.—Introduced to England in 1786 by John Fraser.

R. carolinianum, Rehd. (*R. punctatum*, Small, not Andr.). Shrub to 6 feet tall, but usually lower and rather compact: leaves elliptic to narrow-elliptic, 2–3 inches long, acutish and mucronate or abruptly short-acuminate at apex, broadly cuneate at base, glabrous above, ferrugineous-lepidote beneath, often very densely so: flowers in dense 5–10-flowered clusters; corolla broadly funnelform-campanulate, about 1½ inches across, pale rosy-purple, not or only slightly spotted; tube gradually widened, as long or shorter than the ovate lobes, slightly lepidote outside. Flowers in May or June before or rarely with the young leaves. North Carolina in the mountains.—Introduced before 1814 to England, but for a long time confused with the preceding species. It has proved perfectly hardy at the Arnold Arboretum.

Var. **album,** Rehd. (var. *Margarettæ*, Ashe), is a form with white or nearly white flowers, occurring wild in North Carolina.—Introduced about 1900.

R. Smirnovii, Trautv. Shrub or small tree to 20 feet tall, of rather loose habit; young branchlets, like the petioles, densely covered with whitish or light brown woolly tomentum: leaves elliptic-oblong, 3–5 inches long, acutish, cuneate at base, revolute at the margin, dark green and glabrous above, with yellow midrib, densely covered beneath with white or pale brown woolly tomentum: flowers numerous, on slightly pubescent pedicels in a compact head; calyx small, tomentose; corolla campanulate-funnelform, rosy-purple, 3 inches across; lobes oval, longer than the tube, with crisped darker margin, the upper lobe spotted brownish; ovary tomentose. Flowers in May and June. Caucasus.—Introduced in 1866 by Dr. E. Regel through the Botanic Garden at Petrograd. At the Arnold Arboretum it has proved perfectly hardy; it seems to prefer a well-shaded situation.

The closely related *R. Ungernii*, Trautv., with white to pale rose flowers, was introduced at the same time but has remained rare in cultivation.

R. Metternichii, Sieb. & Zucc. (*R. Hymenanthes*, Makino. *R. japonicum*, Schneid., not Suring.). Shrub to 12 feet tall, but usually lower: leaves oblong to oblong-lanceolate or oblanceolate, 2–5 inches long, obtuse and mucronate or acutish at the apex, narrowed at base, rarely rounded, dark lustrous

green above, densely clothed beneath with close or floccose gray to brown tomentum, the lateral veins not visible: flowers in 7–15-flowered heads; calyx minute, pubescent; corolla campanulate, 7-lobed in the typical form and 2–2½ inches across, pale to deep rosy-pink, not spotted; stamens 14. Flowers in May and June. Japan.—Only the following variety is in cultivation:

Var. **pentamerum,** Maxim. Flowers smaller, 1½–2 inches across, 5-lobed, stamens 10. This is the common wild form in Japan and was introduced to Europe about 1870 and in 1892 by Prof. C. S. Sargent to the Arnold Arboretum where it has proved perfectly hardy.

The related **R. caucasicum,** Pall. can hardly be classed among the taller rhododendrons, as it does not become more than 2 or 3 feet high. It has somewhat smaller and thinner leaves, with the lateral veins visible beneath the closer and thinner brown tomentum; the scales near the base of the leafy branches are persistent and the pink to white flowers are spotted greenish within. It was introduced about 1803 to Great Britain, and has played an important part in the development of the hardy rhododendrons, but the true species is probably not now in cultivation in this country.

R. brachycarpum, D. Don. Shrub to 12 feet tall; young branchlets grayish tomentose: leaves elliptic to oblong-lanceolate, 2½–7 inches long, obtuse and mucronate at apex, narrowed toward the truncate or slightly auriculate base, dark green and reticulate above, covered beneath with dark gray or dun-colored tomentum; petiole pubescent: flowers short-pediceled, in dense clusters; calyx minute; corolla funnelform-campanulate, about 2 inches across, white to yellowish-white, often flushed and striped pink, the upper lobe spotted greenish or brownish; ovary brown-tomentose; style glabrous. Flowers in June. Japan.—Introduced by Dr. G. R. Hall in 1861 to this country. It has proved perfectly hardy near Boston.

R. catawbiense, Michx. Shrub to 6 feet, rarely to 20 feet tall; young branchlets glabrous: leaves oval to oblong, 3–5 inches long, usually obtuse and mucronulate at apex, rounded at base, dark green and lustrous above, glaucescent beneath: flowers in dense clusters; pedicels rusty-pubescent or nearly glabrous; calyx short; corolla broadly campanulate, 2–2½ inches across, with broad roundish lobes, rosy-purple, the upper lobe spotted greenish; ovary rusty-tomentose; style red, glabrous. Flowers in June. Virginia to Georgia on the higher mountains where it often covers extensive tracts.—Introduced to England in 1809 by J. Fraser. Hardy as far north as Massachusetts. This, like the following species, is now extensively used in park-planting and taken by the carloads from the native woods and mountains; if properly handled and taken from turfy soil with a sufficient ball of soil around the roots the shrubs are usually successfully transplanted. *Rhododendron catawbiense* has played the most important part in the development

of the hardy rhododendrons which, therefore, are usually called "Catawbiense hybrids." These hybrids, together with the two native species and the mountain laurel, are the broad-leaved evergreens best adapted for the planting of large groups; they are pleasant to behold all the year round on account of the handsome large foliage and extremely beautiful in spring and early summer when they are covered with masses of showy flowers in various colors.

R. maximum, L. Great Laurel. Shrub or small tree attaining 35 feet in height; young branchlets glandular-pubescent at first, soon glabrous: leaves narrow-oblong to oblong-lanceolate, acute at the ends or short-acuminate at apex, 4–12 inches long, dark green and lustrous above, beneath covered with a pale or brownish, thin and very close scurfy tomentum, rarely glabrous or nearly so at maturity: flowers in 15–24-flowered clusters; pedicels glandular-pubescent; calyx-lobes ovate to oblong, as long or half as long as ovary; corolla campanulate, 1½–2 inches across, deeply 5-lobed, with oval lobes, usually rose-colored, the upper lobe spotted yellowish-green; ovary glandular. Flowers in June and July. Nova Scotia and Ontario south to Georgia, Alabama, and Ohio.—Introduced to Great Britain in 1736. One of the hardiest species, being hardy as far north as Quebec and Ontario. The color of the flower varies from rose-colored, var. **roseum,** Pursh, to purple, var. **purpureum,** Pursh, and white, var. **album,** Pursh.

KALMIA, L.

Evergreen, rarely deciduous shrubs, very rarely a small tree; winter-buds minute, with about two outer scales, the terminal bud wanting; the inflorescence not inclosed during the winter in a bud: leaves alternate or opposite, short-petioled, entire, exstipulate: flowers in axillary or terminal corymbs or umbels, rarely solitary; calyx 5-parted; corolla saucer-shaped or broadly campanulate, 5-lobed; stamens 10, with slender filaments, the anthers held in little pouches of the corolla and the filaments bent back; when the anthers are released, the sudden straightening of the elastic filaments causes the discharge of the pollen-grains; disk 10-lobed; ovary 5-celled, superior; style filiform, exserted, with capitate stigma: fruit a subglobose capsule, separating into 5 valves; seeds numerous, minute. (Named in honor of Peter Kalm, Swedish botanist, traveled from 1748 to 1751 in North America.)—Seven species in eastern North America and Cuba.

K. latifolia, L. Mountain Laurel (American Laurel, Calico Bush). Plate XLVIII. Shrub to 10 feet or rarely small tree to 30 feet tall: leaves alternate, crowded at the end of the branchlets, elliptic-oblong to elliptic-lanceolate, 3–4 inches long, acute at the ends, dark green above, yellowish-green beneath; petiole about ⅔ inch long: flowers on slender glandular-

pubescent pedicels, in terminal compound corymbs; corolla cup-shaped, about ¾ inch across, usually pink with purple markings within, viscid outside: capsule subglobose, scarcely ⅛ inch across. Flowers in May and June. New Brunswick to Florida, west to Ohio and Tennessee.—Introduced to Europe in 1734. Hardy as far north as New England and southern Ontario. One of the most beautiful evergreen flowering shrubs.

Several varieties are in cultivation: Var. **alba,** Bosse, with white flowers; var. **rubra,** Sweet, with deep pink flowers; var. **myrtifolia,** Bosse, with small leaves 1–2 inches long; var. **obtusata,** Rehd., with oval to elliptic-oblong leaves obtuse or nearly so at the ends and 2–3 inches long; the two last named are of slow growth and form low dense bushes.

LEUCOTHÖE, D. Don. (Including *Agarista*)

Evergreen or deciduous shrubs; winter-buds small, with several outer scales; the flower-buds naked: leaves alternate, short-petioled, serrulate, exstipulate: flowers in axillary or terminal racemes; calyx 5-parted, imbricate; corolla ovoid or cylindric; stamens 10; anthers obtuse, or 2-awned or 4-awned at apex, opening by a pore; ovary depressed, 5-celled, style slender: capsule depressed-globose, 5-lobed, the sutures not thickened, separating into 5 valves; seeds minute, irregular. (Leucothoë, daughter of Orchamos, a mythical king of Babylonia.)—About 35 species in North and South America, Japan, Himalayas, and Madagascar.

L. axillaris, D. Don (*Andromeda axillaris*, Lam.). Shrub to 5 feet tall, with spreading and usually recurving branches puberulous when young: leaves elliptic to oblong-lanceolate, 2–4 inches long, abruptly short-acuminate or acute, broadly cuneate at base, rarely rounded, minutely spinulose-serrulate, often entire or nearly so toward the base, lustrous above, pale and sparingly pubescent beneath when young; petiole 1/6–¼ inch long, pubescent: flowers in dense axillary racemes ¾–2 inches long; pedicels very short; sepals broadly ovate; corolla narrowly urn-shaped, about ¼ inch long, white, greenish in bud. Flowers in April and May. Virginia to Florida and Alabama.—Introduced in 1765 to Great Britain. Tenderer than the following species, less handsome and not often seen in cultivation.

L. Catesbæi, Gray (*Andromeda axillaris*, Michx. *A. Catesbæi*, Walt.). Shrub to 6 feet tall, with slender spreading and arching branches reddish when young and puberulous: leaves ovate-lanceolate to lanceolate, 3–7 inches long, long-acuminate, rounded or broadly cuneate at base, ciliate-serrulate, lustrous dark green above, light green beneath, glabrous; petiole ⅓–½ inch long: flowers in axillary racemes 1–2 inches long, occasionally branched and up to 3 inches long; pedicels short; sepals oblong-ovate; corolla narrowly urn-shaped, ½ inch long, white, usually reddish in bud: capsule depressed-

globose, about 1/6 inch across. Flowers in May. Virginia to Georgia, along the mountains.—Introduced in 1793 to Great Britain. Hardy as far north as Massachusetts in sheltered positions. Much planted as a border shrub for groups of taller evergreens; very handsome and effective with its large lustrous leaves.

Var. **Rollissonii,** Bean (*Andromeda Rollisonii,* Hort.). Leaves smaller and narrower, 2–4 inches long and 1/2–3/4 inch wide.

PIERIS, D. Don. (Plate XLVII).

Evergreen or deciduous shrubs, rarely small trees; winter-buds small with several outer scales; the inflorescence not inclosed in a bud: leaves alternate, short-petioled, entire or serrulate, exstipulate: flowers in often panicled racemes, or in axillary clusters on branches of the previous season; sepals valvate or distinct; corolla globose or urceolate, with 5 short lobes; stamens 10; anthers obtuse with a pair of awns near the base or the filaments 2-toothed below the apex; ovary 5-celled; style slender: fruit a capsule separating into 5 dehiscent valves; seeds minute, linear-oblong, not winged. (Pieris, daughter of Pieros, a mythological king.)—About 10 species in North America and in eastern Asia south to the Himalayas.

P. floribunda, Benth. & Hook. (*Andromeda floribunda,* Pursh. *Portuna floribunda,* Nutt.). Dense much-branched shrub, 2–6 feet tall; branchlets and petioles with strigose brown hairs: leaves ovate-oblong to oblong-lanceolate, 1 1/2–2 1/2 inches long, acute or acuminate, minutely serrulate and ciliate, otherwise glabrous, glandular-dotted beneath: flowers white, nodding, on short pedicels in terminal dense upright panicles 1 1/2–4 inches long; corolla urceolate-ovoid, strongly 5-angled, 1/4 inch long. Flowers April and May. Virginia to Georgia in the Alleghanies.—Introduced in 1800 to Great Britain. Perfectly hardy near Boston.

P. japonica, D. Don (*Andromeda japonica,* Thunb.). Shrub with spreading branches, or sometimes small tree to 30 feet tall; branchlets glabrous: leaves crowded at the ends of the branchlets, obovate-lanceolate or oblanceolate, 1 1/2–2 1/2 inches long, acuminate, cuneate at base, crenulate-serrulate, glabrous, dark green and lustrous above, light green beneath: flowers white, in spreading and drooping terminal panicles, 2 1/2–5 inches long; corolla urceolate-ovoid, not angled, 1/4 inch long. Flowers in April and May. Japan.—Introduced to Europe some time before 1870. Hardy only in sheltered positions near Boston, and in severe winters the flower-buds sometimes suffer. Very handsome and graceful when in bloom.

OLEACEÆ. OLIVE FAMILY

OSMANTHUS, Lour.

Evergreen shrubs or small trees; winter-buds small, with 2 outer scales: leaves opposite, short-petioled, entire or toothed, exstipulate: flowers axillary or terminal, in cymes or short panicles, perfect, polygamous, or dicœcious, rather small, white; calyx short, 4-toothed; corolla with short tube and 4 imbricate lobes; stamens 2, rarely 4; ovary 2-celled: fruit an ovoid drupe with a one-seeded stone. (Name derived from Greek *osme*, odor, and *anthos*, flower; in reference to the fragrant flowers.)—About 10 species in eastern and southern Asia, in Polynesia and North America.

O. Aquifolium, Sieb. (*Olea Aquifolium*, Sieb. & Zucc. *Olea ilicifolia*, Hassk.). Shrub or small tree to 20 feet tall, glabrous: leaves short-petioled, elliptic or ovate to ovate-oblong, 1–2 inches long, spiny-pointed and with 2–4 strong spiny teeth on each side, rarely entire, lustrous and dark green above, light green beneath: flowers fragrant, scarcely $\frac{1}{8}$ inch across, on slender pedicels, in axillary clusters; segals entire; corolla divided nearly to the base into reflexed lobes: fruit ovoid, $\frac{1}{2}$–$\frac{3}{4}$ inch long, bluish-black. Flowers in June and July. Japan.—Introduced in 1856 to Great Britain by Thomas Lobb. Hardy as far north as southern New York and in sheltered positions probably farther north.

Several varieties are in cultivation; the most important are var. **myrtifolius,** Nichols., with smaller, entire, acute or acuminate leaves, and var. **rotundifolius,** Nichols., with broader often obovate leaves about 1 inch long and entire or with few obtusish teeth; both are of lower and more compact habit than the type.

PART IV

INVENTORY OF WOODY EVERGREENS GROWN IN NORTH AMERICA

CHAPTER VIII

CHECK-LIST OF WOODY EVERGREENS

THE number of plants that may be listed as evergreens in one or another part of North America is very large. It is manifestly impracticable to endeavor to describe all of these plants in a single volume. It will aid the grower, however, to have before him an alphabetic list of such plants, of a woody and therefore enduring nature, as are offered for sale in the country or are recommended by landscape planters and others. This list is compiled by Prof. Ralph W. Curtis, of the New York State College of Agriculture at Cornell University, specially for this book. It should serve a good purpose as a record of our resources and also as a suggestive planting-list.

In subtropical and tropical regions are many plants green the year around, not being deciduous, that are not entered in this check-list. These constitute quite another problem.

EXPLANATIONS

B means broad-leaved evergreen.
P means protect by cover or sheltered position north of New York City.
R means rare in northern plantings.
S means semi-evergreen, i.e., holding leaves late in the fall.
T means tender below 20° F. when dormant, i.e., same range as oranges.
1 means northeastern States.
2 means Southern States and California, except in the more mountainous regions. Under the latter conditions both in the South and on the west coast many plants marked 1 will succeed and many plants marked 2 will be tender.

All plants marked 1P should succeed in the South and on the west coast as far north as Oregon and Washington. The natural range of each plant is given in the text. With this in mind and with due regard for special soil requirements, the grower should be able to adjust individual cases.

Regarding the use of northern evergreens in the South, Norman C. Butts, of Ashford Park Nurseries, Atlanta, Georgia, writes as follows: "It is possible to grow here anything that will grow in New York, but there are many things which are not satisfactory unless given conditions that will help them overcome summer heat. Partial shade, rich soil, plenty of moisture and a northern slope, all help."

All plants marked 1S (semi-evergreen North) should be more than semi-evergreen, or even wholly evergreen, in the South and on the west coast. The latter region is also the natural home for cone-bearing evergreens and all kinds succeed remarkably there. Taylor and Cooper in "The Complete Garden" call attention to two marked exceptions in broad-leaved evergreens for Oregon and Washington. These are *Camellia japonica* which is much planted in the South, and *Kalmia latifolia* which is native in the Northeast and there considered one of the best broad-leaved evergreens. Neither of these plants is proving successful in Oregon and Washington.

Aarons Beard. See Hypericum calycinum.

1BPS Abelia grandiflora (A. rupestris, Hort.). Hybrid Abelia. Graceful arching shrub to 8 ft. E. and cent. Asia. Cult. South and Calif., and hardy north to Phila.

2BT Aberia caffra. See Dovyalis caffra.

NOTE.—No Abies seem to succeed in the South except in the mts.

Abies baborensis. See A. numidica.

1R Abies balsamea. Balsam Fir. Tree 50–80 ft. E. N. Amer. from Labrador to Iowa.

Abies brachyphylla. See A. homolepis.

Abies cephalonica. Tree 60–70 ft. Mt. Enos on Isle of Cephalonica.

1PR Abies cilicica. Tree 45–60 ft. High elevations in Asia Minor.

1 Abies concolor (A. Parsonsiana, Hort.). White Fir. Tree 100–250 ft. S. Ore. to Low. Calif. Best and commonest fir in northern plantings.

1R Abies Fraseri. Fraser Fir. She Balsam. Tree 30–50 ft. Mts. of Va., Tenn., and N. C. Resembles the more northern balsam.

1 Abies homolepis (A. brachyphylla). Nikko Fir. An excellent new type from Japan, as hardy as A. concolor. These two are the best firs in northern plantings.

1P Abies Nordmanniana. Nordmann Fir. Tree 100–150 ft. Mts. south and southeast of Black Sea. Has rich dark foliage but is a little tender North.

2 Abies numidica (A. baborensis). Algerian Fir. N. Afr.

2 Abies Pinsapo. Spanish Fir. Tree to 80 ft. Mts. of Spain. Not hardy north of the Middle States.

1 Abies Veitchii. Tree 80–100 ft. Mts. of cent. Japan. A beautiful tree next to A. concolor and A. homolepis in northern plantings.

2BT Abutilon striatum. Shrub S. Brazil to Buenos Aires. Cult. Calif.

2B Acacia armata (A. undulata. Mimosa paradoxa). Kangaroo-Thorn. Shrub 7–11 ft. Australia. Cult. South and Calif.

2BT Acacia Baileyana. Shrub or small tree from Australia. Cult. Calif.

2B Acacia cultriformis (A. cultrata). Tall shrub. Australia. Cult. Calif.

2B Acacia Farnesiana (A. leptophylla). Popinac. Cassie. Branching shrub 6–10 ft. Asia, Afr., S. W. U. S., Australia. Cult. Fla. and Calif.

2BT Acacia longifolia. Sydney Golden Wattle. Tall shrub or small tree. Australia. Cult. Fla. and Calif.

2B Acacia melanoxylon. Blackwood Acacia. Pyramidal tree. Succeeds in alkali soil. Breeder of citrus-scale. Cult. Calif.

2B Acacia pravissima. Small tree 15–20 ft. Australia. Cult. Calif.

2B Acacia pycnantha (A. petiolaris). Broad-leaved Wattle. A small tree with somewhat pendulous branchlets. Australia. One of the hardiest acacias in Calif.

2B Acacia retinodes. Tall shrub or small tree. Alkali resisting. Australia. Cult. Calif.

2B Acacia verticillata. Spreading shrub or small tree. Australia. Cult. Calif.
Achania Malvaviscus. See Malvaviscus arboreus.
Achania mollis. See Malvaviscus mollis.
2BT Agathis robusta (Dammara robusta). Tall tree. Australia.
2BT Agonis flexuosa. A tall shrub or small tree. Australia. Cult. Calif.
1BS Akebia quinata. Twining vine. China and Japan. Cult. South.
2BT Alectryon excelsum (sometimes sold in Calif. as Nephelium Litchi). Tree 30–60 ft. New Zeal.
2BT Allamanda neriifolia. Dwarf shrub or half climber. Brazil. Cult. South.
Alpine Azalea. See Loiseleuria procumbens.
2BT Alsophila australis. Tree Fern. Tasmania and Australia. Cult. Fla. and Calif.
1BR Alyssum gemonense. Low plant making mats to 1 ft. Eu.
Andromeda acuminata. See Leucothoë populifolia.
Andromeda calyculata. See Chamædaphne calyculata.
Andromeda Catesbæi. See Leucothoë.
Andromeda ferruginea. See Lyonia ferruginea.
Andromeda formosa, nitida, ovalifolium. See Pieris formosa, lucida, ovalifolia.
1BR Andromeda glaucophylla. Bog Rosemary. Similar to A. polifolia. N. E. Amer., south to Minn. and Pa.
1BR Andromeda polifolia (A. rosmarinifolia). Marsh Andromeda. Wild Rosemary. Low shrub to 2 ft. N. Eu. N. Asia.
Andromeda tetragona. See Cassiope.
Andromeda. See Pieris and Leucothoë.
2BT Anthyllis Barba-Jovis. Jupiters Beard. Shrub 3–8 ft. S. Eu. Cult. Calif.
Aralia japonica. See Fatsia japonica.
2T Araucaria araucana. Monkey-Puzzle. Tree to 100 ft. in Chile. Cult. Fla. and Calif. See note under A. Bidwillii.
2T Araucaria Bidwillii. Bunya-Bunya. Tree to 150 ft. in Australia. This and A. araucana are the hardiest araucarias but both suffer from extreme heat and are better in a shady sheltered situation. Cult. Fla. and Calif.
Araucana imbricata. See A. araucana.
Arbor-vitæ, Chinese or Eastern. See Thuja orientalis.
Arbor-vitæ, Common. See Thuja occidentalis.
Arbor-vitæ, Siberian. See Thuya occidentalis var. robusta.
2B Arbutus Menziesi (A. procera). Madrona. Tree to 50 ft. W. N. Amer. Cult. N. W. coast.
Arbutus mucronatus. See Pernettya mucronata.
Arbutus, Trailing. See Epigæa repens.
2B Arbutus Unedo. Strawberry Tree. Tree 8 to 15 ft. S. Eu., Ireland. Cult. South and Calif.
Arbutus Uva-ursi. See Arctostaphylos Uva-ursi.
2BT Archontophœnix Alexandræ (Ptychosperma Alexandræ). Tree 70–80 ft. Queensland. Cult. Fla. and Calif.
2BT Archontophœnix Cunninghamii (Seaforthia elegans). Queensland, New S. Wales. Cult. Fla. and Calif.
2B Arctostaphylos bicolor. Shrub 3–4 ft. Calif.
2B Arctostaphylos Pringlei. Shrub. Calif., Ariz.
1BR Arctostaphylos Uva-ursi (Arbutus Uva-ursi). Bearberry. Trailing shrub. N. Amer. south to Mex. Cult. N. W. coast.
2B Arctostaphylos viscida. Shrub 5–15 ft. Ore. to Calif.
2B Ardisia crispa (A. crenulata). Shrub. E. Indies and China. Cult. Fla.

2BT Arecastrum Romanzofflanum var. australe (Cocos Arechavalenta, C. australis, and C. Datil). Pindo Palm. Tree to 30 ft. Brazil, Argentina, Paraguay and Uruguay. Safer with some shade in Calif. and Fla.

2B Artemisia arborescens. Shrub from Medit. Cult. as shrub to 6 ft. Calif.

1BPR Arundinaria japonica (Bambusa Metake). Japanese or Evergreen Bamboo. Japan. Shrubby, 3–5 ft. North and one of the best for city planting. Commonly cult. South to 15 ft.

2B Arundinaria macrosperma. Large Cane. 15–25 ft. Va. to Key. southward.

2B Arundinaria nitida. 6–10 ft. China. Dainty bamboo, very hardy.

2BT Asparagus asparagoides. Smilax. Twining vine. Smilax of florists. S. Afr. Cult. Calif.

2BT Asparagus plumosus. Asparagus-Fern. Tall woody climbing vine. S. Afr. Cult. Calif.

2BT Asparagus plumosus var. comorensis. More robust than A. plumosus. Cult. Calif.

Assonia. See Dombeya.

Astrapæa. See Dombeya.

Atalantia buxifolia. See Severinia buxifolia.

2BT Atriplex Breweri. Woody shrub 4–6 ft. S. Calif.

2B Aucuba japonica. Stout shrub 4–15 ft. Himalayas to Japan. Cult. South and Calif.

Australian-Beech. See Eucalyptus polyanthemos.

Australian Bluebell Creeper. See Sollya heterophylla.

Australian Brush-Cherry. See Eugenia myrtifolia.

Australian Pea. See Dolichos lignosus.

Avocado. See Persea americana.

Azalea. See Rhododendron and Loiseleuria.

2B Azara microphylla. Shrub 3–12 ft. Chile. Cult. South and W. coast.

1BS Baccharis halimifolia. Groundsel-Tree. Shrub 3–12 ft. Seacoast from New England south.

Balsam. See Abies.

Bamboo. See Arundinaria, Bambusa, and Phyllostachys.

Bambusa Metake. See Arundinaria japonica.

2B Bambusa palmata. Shrub 2–5 ft. Japan. Cult. South and Calif.

Banana-Shrub. See Michelia fuscata.

Barberry. See Berberis.

Bayberry. See Myrica carolinensis.

Bearberry. See Arctostaphylos Uva-ursi.

Bear-Grass. See Yucca angustifolia.

2B Beaumontia grandiflora. Tall-growing woody vine. India and Java.

Beefwood. See Casuarina equisetifolia.

Benthamia fragifera. See Cornus capitata.

Berberis Aquifolium. See Mahonia Aquifolium.

Berberis Bealii. See Mahonia japonica.

1BPR Berberis buxifolia. Box-leaved Barberry. Shrub 1–3 ft. This plant comes from Chile. It is growing at Cornell with only snow protection in winter and is the only woody ornamental from the southern hemisphere now cultivated in the N. E. States.

2B Berberis Darwinii. Shrub 3–5 ft. Chile to Patagonia. Cult. South and N. W. coast.

1BPR Berberis Gagnepainii. Shrub to 6 ft. W. China.

2B Berberis hakeoides (B. congestiflora). Shrub to 6 ft. Chile. Cult. South.
Berberis ilicifolia. See B. Neubertii.
Berberis japonica. See Mahonia japonica.
1BPR Berberis Julianæ. Shrub similar to B. Sargentiana. Cent. China.
1BPS Berberis Neubertii (B. ilicifolia). Holly-leaved Barberry. Shrub to 8 ft. A hybrid between Berberis vulgaris and Mahonia Aquifolium. Foliage intermediate, drying and turning brown in winter and both single and trifoliate leaves on same plant. Cult. South and N. W. coast.
2B Berberis pruinosa. Shrub. S. W. China.
1BPR Berberis Sargentiana. Shrub to 6 ft. W. China. Cult. South.
1BPR Berberis stenophylla (B. Darwinii × B. empetrifolia). Shrub 1–3 ft. with small narrow leaves.
2B Berberis trifoliata (Mahonia trifoliolata). Tex. to Mex.
1BPR Berberis verruculosa. Shrub to 3 ft. W. China. This is more hardy than B. Sargentiana.
2B Berberis Wilsonæ. Low shrub. W. China. Semi-evergreen North if sheltered.

NOTE.—See Mahonia for all evergreen barberries having compound leaves except the intermediate hybrid, B. Neubertii (B. ilicifolia) above.

Bignonia alba. See Pithecoctenium cynanchoides.
Bignonia callistegioides. See Clytostoma callistegioides.
2B Bignonia capreolata. Trumpet-Flower. Cross-Vine. Climbing vine. Md., south and west. Also cult. South and Calif.
Bignonia Cherere. See Phædranthus buccinatorius.
Bignonia echinata. See Pithecoctenium muricatum.
Bignonia jasminoides. See Pandorea jasminoides.
Bignonia purpurea. See Clytostoma purpureum.
Bignonia speciosa. See Clytostoma callistigioides.
Bignonia Unguis-cati. See Doxantha Unguis-cati.
Bignonia venusta. See Pyrostegia venusta.
Biota orientalis. See Thuja orientalis.
Bittersweet, Evergreen. See Euonymus radicans.
Blackwood Acacia. See Acacia melanoxylon.
Boretta. See Dabœcia.
Bottle-Brush. See Callistemon speciosus.
Bower-Plant of Australia. See Pandorea jasminoides.
Box. See Buxus.
Box Huckleberry. See Gaylussacia brachycera.
Boxwood. See Buxus sempervirens.
2BT Brachychiton acerifolium (Sterculia acerifolia). Flame-Tree. Tree to 60 ft. Australia.
2BT Brachychiton populneum (Sterculia diversifolia). Brachychiton. Tall tree. Australia. Planted in Calif.
2BT Brahea calcarea. Palm 8–15 ft. Mex. Cult. Calif.
Brahea edulis. Wendl. See Erythea edulis.
2BT Brahea Pimo. Rare—known in trade only at Santa Barbara, Calif.
Broad-leaved Wattle. See Acacia pycnantha.
Broom Crowberry. See Corema.
Broom, Scotch. See Cytisus scoparius.
Browallia Jamesonii. See Streptosolen.
1R Bruckenthalia spiculifolia (Erica spiculifolia). Tufted shrub 5–8 ft. S. E. Eu. Asia Minor.
Bryanthus. See Phyllodoce.

2BS Buddleia Davidii (B. variabilis). Shrub 3–12 ft. China. Cult. South. Grown in the North as herbaceous perennial and cut to the ground in the fall.

2B Buddleia japonica (B. curviflora). Shrub 3–6 ft. Japan. Cult. South. Grown in the North as herbaceous perennial and cut to the ground in the fall.

2BT Buddleia madagascariensis (B. heterophylla). Shrubby vine. Madagascar. Cult. Calif.

Bull Bay. See Magnolia grandiflora and Persea Borbonia.

2B Bumelia angustifolia. Shrub or small tree to 25 ft. Fla.

2B Bumelia lanuginosa. Chittim Wood. Tree to 50 ft. Southern States north to S. Ill., west to Tex.

2B Bumelia tenax. Shrub or small tree to 30 ft. N. C. to Fla.

Bunya-Bunya Tree. See Araucaria Bidwillii.

Butchers Broom. See Ruscus aculeatus.

2BT Butea Bonnetii (Cocos Bonnetii). A tree palm, hardy but rarely cult. in Calif.

2BT Butea capitata var. odorata (Cocos odorata). A short-stemmed palm. Brazil. Best with shade.

2BT Butea capitata var. pulposa (Cocos pulposa). Brazil. Best with shade.

2BT Butea Yatay (Cocos Yatay). Palm with stem 8–15 ft. high. Brazil and Argentina.

2B Buxus balearica. Shrub 6–15 ft. S. Spain. Cult. South.

1BR Buxus microphylla var. japonica (B. japonica). Dense shrub to 6 ft. Japan. Hardy at Boston and Rochester.

1BP Buxus sempervirens (many varieties). Common Box or Boxwood. Shrub or small tree to 25 ft. S. Eu., N. Afr., Orient, China. Cult. North, South, and West.

California Big-Tree. See Sequoia gigantea.

California Pepper-Tree. See Schinus Molle.

2B Callistemon lanceolatus (Metrosideros semperflorens and M. floribunda, Hort.). Shrub 6–12 ft. Australia. Cult. Fla. and Calif.

2B Callistemon speciosus. Bottle-Brush. Large shrub. Australia. Cult. Calif.

1PR Calluna vulgaris (Erica vulgaris). Heather, Ling. Shrub ½–3 ft. W. and N. Eu. and Asia Minor. Naturalized in E. N. Amer. and cult. N. W. coast. Succeeds South under favorable conditions.

2T Calothamnus quadrifidus. Shrub to 5 ft. W. Australia. Cult. Calif.

2B Camellia japonica (Thea japonica). Camellia. Shrub or small tree. China, Japan. Cult. South and Calif.,

Camellia Thea. See Thea sinensis.

Camphor-Tree. See Cinnamomum Camphora.

Camphora officinarum. See Cinnamomum Camphora.

Candytuft, Evergreen. See Iberis sempervirens.

Cane. See Arundinaria macrospermum.

2BT Cantua buxifolia. Shrub 4–8 ft. Peru. Cult. Calif.

Cape Honeysuckle. See Tecomaria capensis.

Cape Jasmine. See Gardenia jasminoides.

Cape Pittosporum. See Pittosporum viridiflorum.

2BT Capparis spinosa. Shrub to 3 ft. Medit. region and India. Cult. Calif.

Caprifolium. See Lonicera fragrantissima.

Caprifolium sempervirens. See Lonicera sempervirens.

2B Cardiospermum hirsutum. Climbing vine. Afr. Cult. Calif.

2BT Carissa Arduina (C. bispinosa). Similar to C. grandiflora. Cult. Fla. and Calif.

2BT Carissa grandiflora. Natal-Plum. Spiny shrub to 4 ft. S. Afr. Cult. Fla. and Calif.

Carob. See Ceratonia Siliqua.

Carolina Yellow Jessamine. See Gelsemium sempervirens.

2B Carpenteria californica. Native shrub 6–10 ft. Calif.

Cassandra calyculata. See Chamædaphne calyculata.

Cassena. See Ilex vomitoria.

2BT Cassia artemisioides. Bushy shrub 4 ft. Australia. Cult. Calif.

2B Cassia corymbosa (C. floribunda). Shrub 4–10 ft. Argentina. Cult. South.

2BT Cassia tomentosa. Shrub 10–12 ft. Mex. Cult. Calif.

Cassie. See Acacia Farnesiana.

1R Cassiope hypnoides (Harrimanella hypnoides). Small alpine shrub. High alt. of N. Amer., N. Eu., N. Asia and Himalayas.

1R Cassiope tetragona (Andromeda tetragona). Very small shrub. Arctic regions.

Castanea chrysophylla. See Castanopsis.

2B Castanopsis chrysophylla (Castanea chrysophylla). Tree to 150 ft. Ore. to Calif. The shrubby form in the mts. is more hardy than the type.

2 Casuarina equisetifolia. Beefwood. Australian-Pine. Tree from Old World tropics. Cult. in Fla. and Calif. to 25 ft. Succeeds in alkali soil.

2B Ceanothus arboreus. Small tree. Isles off Calif. coast.

2B Ceanothus cuneatus. Tall much-branched shrub. Ore. to Calif.

1BRS Ceanothus Fendleri. Prostrate spiny shrub. S. Dak. to N. Mex. Semi-evergreen.

2B Ceanothus prostratus. Procumbent shrub. Wash. to Calif.

2B Ceanothus spinosus. Tall shrub. Cent. and S. Calif.

2B Ceanothus thyrsiflorus. Shrub to 10 ft. Ore. to Calif.

2B Ceanothus velutinus. Tall shrub. Brit. Col. to Colo. and Calif.

Cedar, African. See Cedrus atlantica.

Cedar, Chinese. See Juniperus chinensis.

Cedar of Lebanon. See Cedrus libani.

Cedar, Red. See Juniperus virginiana.

Cedar, Southern Red. See Juniperus lucayana.

Cedar, White. See Thuja occidentalis, Chamæcyparis thyoides and Libocedrus decurrens.

Cedar, Yellow. See Chamæcyparis nootkatensis.

1PR Cedrus atlantica. African Cedar. Large pyramidal tree, N. Afr. Cult. South and N. W. coast to Wash.

1PR Cedrus atlantica var. glauca. Cult. South and N. W. coast to Wash.

2 Cedrus Deodara. Deodar. Tall pyramidal tree to 150 ft. Himalayas. Cult. South.

1PR Cedrus libani. Cedar of Lebanon. Large broad tree. N. Afr. Cult. South and N. W. coast.

1PR Cephalotaxus drupacea. Shrub 3–5 ft. Japan. Cult. South.

2 Cephalotaxus drupacea var. fastigiata (C. pedunculata var. fastigiata. Podocarpus koraiana). Columnar form to 10 ft. Cult. South. The type is a small tree to 25 ft. in Japan but shrubby in cultivation.

2 Cephalotaxus Fortuni. Normally a tree but usually shrubby in cultivation. N. China and Japan. Cult. South.

Cerasus Laurocerasus. See Prunus Laurocerasus.

2 Ceratiola ericoides. Southern Heather. Shrub 2–8 ft. Sand barrens of S. C. to Fla. and Ala.

2B Ceratonia Siliqua. Carob. Tree 40–50 ft., from Medit. region. Cult. as shrub 8–10 ft. in Calif.

1BPR Cercocarpus parvifolius. Mountain-Mahogany. Bushy tree to 25 ft. Neb. and Ore. to Low. Calif. and W. Tex. More shrubby in cult.

2BT Cestrum aurantiacum. Half-climbing shrub. Guatemala. Cult. Fla. and Calif.

2BT Cestrum elegans. Red Coral Jasmine. Half-climbing slender shrub. Mex. Cult. Fla. and Calif.

2BT Cestrum fasciculatum. Similar to C. elegans. Mex. Cult. Calif.

2BT Cestrum laurifolium. Glabrous shrub. W. Indies., S. Amer. Cult. Calif. (C. diurnum?).

2BT Cestrum Parqui. Shrub from Chile. Cult. in Fla. and Calif.

Chamæcistus. See Loiseleuria.

Chamæcyparis. See Retinispora.

2 Chamæcyparis Lawsoniana. Lawson Cypress. Tree to 200 ft. Ore. to Calif. Cult. South and N. W. coast.

1PR Chamæcyparis nootkatensis (Thuja borealis, Hort.). Yellow Cedar. Nootka Cypress. Tree to 120 ft. Sitka to Ore. Hardy at Cornell.

1 Chamæcyparis (Retinispora) obtusa. Hinoki Cypress. Tree. Japan. Cult. South and N. W. coast.

1 Chamæcyparis (Retinispora) obtusa nana. Low form of obtusa, slow-growing.

1 Chamæcyparis (Retinispora) pisifera. Sawara Cypress. Tree. Japan. Cult. South and N. W. coast.

1 Chamæcyparis (Retinispora) pisifera filifera. Tree. Japan. Cult. South and N. W. coast.

1 Chamæcyparis (Retinispora) pisifera plumosa. Tree. Japan. Cult. South and N. W. coast.

1 Chamæcyparis (Retinispora) pisifera squarrosa. Bushy tree. Japan. Cult. South and N. W. coast.

1R Chamæcyparis thyoides. White-Cedar. Tree 70–80 ft. Maine to Fla. west to Miss. Cult. South.

1BRS Chamædaphne calyculata (Andromeda calyculata. Cassandra calyculata). Spreading shrub 1–3 ft. Leaves brown in winter. Bogs, Lab. to Brit. Col., south to Minn., Wis., Ill., and Ga.

Chamærops excelsa (C. Fortunei). See Trachycarpus excelsa.

2BT Chamærops humilis in variety. Low fan-leaved palm from Medit. Cult. in Calif. to 6 ft.

Chamærops hystrix. See Rhapidophyllum.

Checkerberry. See Gaultheria procumbens.

Cherokee Rose. See Rosa lævigata.

Chilean Guava. See Myrtus ugni.

1BR Chimaphila maculata. Spotted Wintergreen. Lower than C. umbellata. Canada to Ga. and Miss.

1BR Chimaphila umbellata (C. corymbosa) Princes-Pine or Pipsissewa. Small half-shrubby plant 5–12 inches. Canada to Mex., Eu., Japan.

Chinese Hibiscus. See Hibiscus Rosa-sinensis.

Chinese Matrimony Vine. See Lycium chinense.

Chinese Windmill Palm. See Trachycarpus excelsa (T. Fortunei).

1BR Chiogenes hispidula. Creeping Snowberry. Creeping plant. Canada south to Minn., Mich., and N. C. in peat bogs and mossy woods.

Chittim Wood. See Bumelia lanuginosa.

2B Choisya ternata. Mexican Orange. Shrub 4–8 ft. Mex. Cult. N. W. coast.

2BT Chorizema ilicifolium. Weak shrub to 5 ft. Australia. Cult. Calif.

Christmas Berry. See Heteromeles arbutifolia.

Christmas Green. See Lycopodium.

Christmas-Tree of New Zealand. See Metrosideros tomentosa.
Cinnamon-Tree. See Cinnamomum zeylanicum.
2BT Cinnamomum Camphora (Camphora officinarum). Camphor-Tree. Tree to 40 ft. China, Japan. Cult. South.
2BT Cinnamomum zeylanicum. Cinnamon-Tree. Small tree 20–30 ft. India and trop. countries. Cult. South.
Cinquefoil, Three-toothed. See Potentilla tridentata.
2BT Cissus (Vitis) antarctica. Kangaroo-Vine. Upright shrub, branches climbing by tendrils. Australia. Cult. Calif. Succeeds on walls in dark neglected places.
2BT Cissus (Vitis) capensis. Evergreen Grape-Vine. Strong climbing vine. S. Afr. Cult. Calif. and Fla.
2B Cissus striata. Shrubby vine. Chile, S. Brazil. Cult. Calif.
Cistus algarvense. See Helianthemum ocymoides.
2B Cistus ladaniferus var. maculatus. Shrub to 4 ft. S. W. Eu. Cult. in Calif.
2B Cistus laurifolius. Shrub to 6 ft. S. W. Eu. Cult. South and Calif.
Citrus aurantifolia. See Lime.
2BT Citrus Aurantium. Sour or Seville Orange. Medium tree. Cosmopolitan, naturalized in Fla.
Citrus buxifolia. See Severinia buxifolia.
2BT Citrus grandis. Grapefruit, Shaddoch, Pummelo. Large tree. S. and W. U. S. and W. Indies.
Citrus japonica. See Fortunella japonica.
Citrus Limonia. See Lemon.
2BT Citrus nobilis. King Orange. Small tree. Cochin-China.
2BT Citrus nobilis var. deliciosa. Mandarin Orange. Tangerine Orange. Small tree. India.
2BT Citrus sinensis. Common Sweet Orange. Medit. tree. Widely cult. in tropical and subtropical regions. The main orange sections in the U. S. are (1) Cent. and S. Fla., (2) southern parts of La., Tex. and Ariz., and (3) Calif., along the southern coast from San Diego to Shasta Co. and in the foothills of the great interior valleys of the Sacramento and the San Joaquin.
2B Clerodendron fœtidum. Spreading shrub 3–6 ft. China. Cult. South and Calif.
2B Clerodendron fragrans. Shrubby. China, Japan. Cult. South and Calif.
2BT Clerodendron Siphonanthus. Turks-Turban. Shrub 2–8 ft. E. Indies. Cult. Fla. and Calif.
2B Clerodendron trichotomum. Slender, erect, graceful subshrub, 4–10 ft. Japan. Cult. South and Calif.
Cleyera japonica, Sieb. & Zucc. See C. ochnacea.
Cleyera japonica Thunb. See Ternstrœmia japonica.
2BT Cleyera ochnacea (C. japonica, Sieb. & Zucc.). Shrub to 6 ft. Himalayas. Cult. South.
2BT Clianthus puniceus. Parrots-Bill. Half-trailing shrub, 3–6 ft. New Zeal. Cult. Calif.
Club Moss. See Lycopodium.
2BT Clytostoma callistegioides (Bignonia callistegioides and B. speciosa). South American Cross-Vine. Climbing vine. S. Brazil, Argentina. Cult. Calif.
2BT Clytostoma purpureum. Climbing vine. Uruguay. Cult. Calif.
2BT Cneorum tricoccon. Spurge Olive. Shrub 1–2 ft. S. Eu. Cult. Calif.
2B Coccothrinax Garberi. Silver Palm. A dwarf palm. Biscayne Bay, Fla.
Coconut Tree. See Cocos nucifera.
Cocos Arechavaletana. See Arecastrum Romanzoffianum var. australe.
Cocos australis. See Arecastrum Romanzoffianum var. australe.

Cocos Bonnetii. See Butea Bonnetii.
Cocos campestris. See Syagrus campestris.
Cocos Datil. See Arecastrum Romanzoffianum var. australe.
2BT Cocos nucifera. Coconut tree. 40–100 ft. Seashores within the tropics. Cult. South and Calif.
Cocos odorata. See Butea capitata var. odorata.
Cocos pulposa. See Butea capitata var. pulposa.
Cocos Yatay. See Butea Yatay.
Coffee-Berry. See Rhamnus californica.
Colutea galegifolia. See Swainsona.
Convolvulus floridus. See Rhodorhiza florida.
Coontie or Comptie. See Zamia floridana.
2BT Coprosma Baueri. Shrub or small tree. New Zeal. Cult. Calif.
Coral-Bush. See Templetonia retusa.
Coral Gem. See Lotus Berthelotii.
2B Cordyline australis. Tree 40–50 ft. New Zeal. Common in Calif.
1R Corema Conradii. Broom Crowberry. Much branched shrub 2 ft. E. N. Amer. in sandy pine-barrens and dry rocky places.
2B Cornus californica. Shrub 6–15 ft. Coastal plain, San Francisco to San Diego. Deciduous but often holding foliage late in the winter.
2B Cornus capitata (Benthamia fragifera). Himalayas. Cult. South and N. W. coast.
2B Coronilla Emerus. Scorpion Senna. Dense symmetrical shrub, 3–5 ft. S. Eu. Cult. South.
2B Coronilla glauca. A shrubby vetch, 3–5 ft. S. Eu. Commonly cult. Calif.
2BT Corynocarpus lævigata. New Zealand Laurel. Tree 30–40 ft. New Zeal. Cult. Calif.
Corypha australis. See Livistona australis.
1BPRS Cotoneaster adpressa (C. horizontalis var. adpressa). Prostrate shrub. W. China.
Cotoneaster angustifolia. See Pyracantha angustifolia.
Cotoneaster buxifolia. See C. rotundifolia var. lanata.
Cotoneaster crenulata. See Pyracantha crenulata.
1BPR Cotoneaster Dammeri. Prostrate shrub. Cent. China.
1BPRS Cotoneaster Franchetii. Graceful spreading shrub to 4 ft. W. China. Cult. South and N. W. coast.
2B Cotoneaster frigida. Large shrub, semi-evergreen. Himalayas. Cult. South and Calif.
2BS Cotoneaster horizontalis. Low spreading shrub, branches almost prostrate. China. Semi-evergreen South. Hardy and deciduous North.
2BS Cotoneaster horizontalis perpusilla. Closely resembles the type. Very attractive.
1BP Cotoneaster microphylla. Dense prostrate shrub. Himalayas. Cult. South and Calif.
1BP Cotoneaster microphylla var. thymifolia. Very dwarf, smaller in every part.
2B Cotoneaster pannosa. Semi-evergreen shrub to 6 ft. S. W. China. Cult. Fla. and Calif.
Cotoneaster Pyracantha. See Pyracantha coccinea.
1BPRS Cotoneaster rotundifolia (C. microphylla Uva-ursi). Low or prostrate shrub. Himalayas.
1BPR Cotoneaster rotundifolia var. lanata (C. buxifolia). Cult. South and Calif.
1BPRS Cotoneaster salicifolia var. floccosa. Shrub to 15 ft. W. China.

2BS Cotoneaster Simonsii (C. acuminata var. Simonsii). Shrub to 4 ft. Himalayas. Cult. South and N. W. coast. Deciduous and hardy North.
Cowberry. See Vaccinium Vitis-Idæa.
Cranberry, American or Large. See Vaccinium macrocarpon.
Cranberry, Mountain. See Vaccinium Vitis-Idæa.
Cranberry, Small. See Vaccinium Oxycoccus.
Cratægus crenulata. See Pyracantha crenulata.
Cratægus glabra. See Photinia glabra.
Cratægus Pyracantha. See Pyracantha coccinea.
Creeping Snowberry. See Chiogenes hispidula.
Creeping Thyme. See Thymus Serpyllum.
Cross-Vine. See Bignonia capreolata.
Crowberry, Black. See Empetrum nigrum.
Crowberry, Broom. See Corema.
2 Cryptomeria japonica. Tree. Japan. Cult. South.
1PR Cryptomeria japonica Lobbii. Compact tree. China, Japan.
2 Cunninghamia lanceolata (C. sinensis). Tree to 80 ft. China. Cult. South.
2 Cupressus arizonica. Tree to 40 rarely 70 ft. Ariz. to Calif. and South.
2 Cupressus funebris. Tree to 60 ft. China. Cult. South.
Cupressus glauca. See C. lusitanica.
2 Cupressus Goveniana (C. californica). Tree to 50 ft. Calif.
Cupressus Lawsoniana. See Chamæcyparis Lawsoniana.
2 Cupressus lusitanica (C. glauca. C. sinensis, Hort.). Cypress of Goa. Tree to 50 ft. Naturalized in Portugal and probably introduced from India. Cult. South.
2 Cupressus macrocarpa and var. fastigiata. Monterey Cypress. Tree to 40 ft. Bay of Monterey, Calif. Much cult. Calif.
2 Cupressus Macnabiana. Shrub with several stems or small tree 20 ft. Cult. South and Calif.
2 Cupressus sempervirens in var. Italian or Classic Cypress. Tree to 80 ft. S. Eu., W. Asia. Cult. South.
Cupressus sinensis. See C. lusitanica.
2BT Cycas circinalis. Fern-Palm. S. India, Isls. of Pacific, E. trop. Afr., Guam. Best in partial shade. Cult. middle and southern Fla.
2BT Cycas siamensis. Small palm-like tree. Burma, Siam, Cochin-China. Cult. Fla.
Cyclobalanopsis glauca. See Quercus glauca.
Cypress, Italian or Classic. See Cupressus sempervirens.
Cypress, Japanese. See Chamæcyparis and Retinispora.
Cypress, Lawson. See Chamæcyparis Lawsoniana.
Cypress, Monterey. See Cupressus macrocarpa.
Cypress of Goa. See Cupressus lusitanica.
2B Cyrilla racemiflora. Leatherwood. Shrub or small tree to 20 ft. Variable species ranging from N. C. to Fla., west to Tex. and in W. Indies and S. Amer. In the Southern States foliage turns reddish bronze color in the fall, but remains green in the more tropical parts of its range.
Cytisus albus. See C. multiflorus.
2B Cytisus canariensis. Genista. Much-branched shrub to 6 ft. Canary Isls. Cult. in Calif.
2B Cytisus filipes (Spartocytisus filipes. C. palmensis, Hort.). Shrub with slender branches. Teneriffe. Hardy South. Cult. in Calif.
2B Cytisus monspessulanus (C. candicans). Shrub to 10 ft. Medit. Cult. in Calif.

2B Cytisus multiflorus (C. albus. Spartium multiflorus). Shrub to 3 ft. Spain and N. Afr. Cult. in Calif.

2B Cytisus racemosus. Hybrid. Shrub to 6 ft. Cult. in Calif.

1BPR Cytisus scoparius. Scotch Broom. Shrub to 10 ft. Cent and S. Eu. Practically deciduous North but the mass of green stems 3–4 feet high makes a striking show in winter. Neglected clumps of this plant have established themselves in sheltered positions both in Boston and Rochester.

1PR Daboœcia cantabrica (D. polifolia. Boretta cantabrica. Menziesia polifolia). Irish Heath. Shrub to 2 ft. Ireland, W. France, N. Spain, Azores.

Dædalacanthus nervosus. See Eranthemum nervosum.

Dahoon. See Ilex Cassine.

Dammara robusta. See Agathis robusta.

2B Daphne Blagayana. Low plant like the following. Mts. of S. E. Eu. Cult. South and N. W. coast.

1BR Daphne Cneorum. Garland-Flower. Dense shrub to 2 ft., with creeping branches making a neat mound-like mass. Mts. of cent. Eu. Succeeds South under favorable conditions.

2B Daphne hybrida (D. collina × D. odora). Hardier than D. odora. Erect shrub to 4 ft. Cult. South and Calif.

2B Daphne Laureola. Shrub to 4 ft. S. Eu., W. Asia. Cult. South and Calif.

2B Daphne odora. Shrub to 4 ft. China, Japan. Cult. South and Calif.

2B Daphne pontica. Shrub to 5 ft. S. E. Eu., W. Asia. Cult. South and N.W. coast.

2B Daphniphyllum macropodum (D. glaucescens). Shrub or small tree 5–10 ft. Japan, China. Cult. South and Calif.

Dendrium. See Leiophyllum.

2B Dendromecon rigida. Shrub to 6 ft. Dry parts of coast ranges and Sierras, Calif.

Deodar. See Cedrus Deodara.

Dewberry, Swamp. See Rubus hispidus.

1R Diapensia lapponica. Small alpine shrub, 1–2 ft. Mts. of New England and N. Y.

2BT Dicksonia antarctica. Tree Fern. 30–35 ft. in Australia and Tasmania. Cult. Fla. and Calif.

2BT Dioclea glycinoides. Tender shrubby twiner. Rio de la Plata. Cult. in Calif.

2T Diosma ericoides. Much-branched shrub 1–2 ft. requiring same treatment as Erica. S. W. Afr. Cult. Calif.

2B Dodonæa cuneata. Shrub to 8 ft. Australia. Cult. Calif.

2B Dodonæa viscosa. Shrub to 15 ft. Australia, S. Afr., Mex. Cult. Calif.

2BT Dolichos lignosus and var. alba. Australian Pea. Twining vine. Australia. Highly recommended in S. Calif. and Ariz.

2BT Dombeya natalensis (Assonia natalensis. Astrapæa natalensis). Small tree from Trop. Afr. Cult. Fla. and Calif.

2BT Dovyalis caffra (Aberia caffra). Kei-Apple. Shrub or small tree. Cape of Good Hope. Cult. Calif.

2BT Doxantha Unguis-cati (Bignonia Unguis-cati). Vine. Argentina. Cult. Calif. and Fla.

2BT Duranta repens (D. spinosa. D. Plumieri. Ellisia acuta). Golden Dewdrop. Shrub or small tree. Key West, W. Indies, Mex. to Brazil. Cult. Fla. and Calif.

Dwarf Palmetto. See Sabal glabra.

Dyers Greenweed. See Genista tinctoria.

2B Elæagnus pungens in variety. Spreading shrub to 12 ft. Japan. Cult. South and Calif. Some varieties are vine-like.

2BS Elæagnus umbellata. Japanese Oleaster. Spreading shrub to 12 ft. S. Eu., Asia, N. Amer. Deciduous and hardy North.

Ellisia acuta. See Duranta repens.

1R Empetrum nigrum. Black Crowberry. Low procumbent alpine shrub. Arctic Amer. south to coast of Maine and New England, mts. N. Mich. and coast of Ore.

English Ivy. See Hedera Helix.

1R Ephedra distachya. Low procumbent shrub, 1–3 ft. S. Eu., W. Asia.

1BR Epigæa repens. Trailing Arbutus. Mayflower. Woody creeping plant. N. E. Amer. Needs acid soil.

2BT Eranthemum nervosum (Dædalacanthus nervosus). Tropical shrub, 2–6 ft. India. Cult. Fla.

1PR Erica carnea (E. herbacea). Pink Moor Heath. Dwarf shrub to 6 inches. S. Afr., Medit. region. Hardy at Boston and Rochester.

1PR Erica cinerea. Scotch Heath. Much-branched shrub 8–15 inches. Eu.

2 Erica lusitanica (E. codonodes). Spanish Heath. Low shrub. W. Eu. (Hardy south of N. Y. with protection). Cult. Calif.

2 Erica mediterranea (E. carnea var. occidentalis). Shrub to 3 ft. England. Cult. South and west coast.

2 Erica melanthera. Heath. Shrub to 3 ft. Australia. Cult. Calif.

2 Erica persoluta alba. Cult. Calif.

Erica spiculifolia. See Bruckenthalia.

1PR Erica Tetralix. Bell Heather. 6–12 inches. W. Eu.

1PR Erica vagans. Cornish Heath. Shrub to 12 inches. W. Eu., Medit.

Erica vulgaris. See Calluna vulgaris.

2B Eriobotrya japonica (Photinia japonica). Loquat. Small tree to 20 ft. Japan, China. Cult. South and Calif.

2BT Erythea armata. Blue Palm. Slender tree 40 ft. Lower Calif.

2BT Erythea Brandegeei. Tree to 125 ft., with slender trunk. Lower Calif. Shade.

2BT Erythea edulis (Brahea edulis). Tree 40–50 ft. Calif. Shade.

2BT Erythea elegans. Dwarf; slow-growing. Lower Calif.

2B Escallonia montevidensis. Shrub to 9 ft. S. Amer. Cult. South and Calif.

2B Escallonia pulverulenta. Shrub 8–10 ft. S. Amer. Cult. South and Calif.

2B Escallonia rubra. Dainty shrub to 6 ft. S. Amer. Cult. South and Calif.

2B Escallonia virgata. Dense shrub. S. Amer. Cult. South and Calif.

2BT Eucalyptus amygdalina var. angustifolia. Peppermint Gum. Graceful tree. Australia. Cult. Calif.

2BT Eucalyptus corynocalyx. Sugar Gum. Large tree. Australia. Cult. Calif. Drought resistant.

2B Eucalyptus crebra. Narrow-leaved Ironbark. Small to large tree. Australia. Stands wide range of temperature. Cult. Calif.

2BT Eucalyptus erythronema (E. conoidea). Small ornamental tree. Australia. Cult. Calif.

2BT Eucalyptus globulus. Blue Gum. Tree to 300 ft. Australia. Much cult. Calif.

2BT Eucalyptus leucoxylon (E. gracilipes). White Ironbark. Tall tree. Australia. Much cult. Calif.

2BT Eucalyptus polyanthemos. Red-Box. Australian-Beech. Ornamental tree. Australia. Resists drought and heat and is fairly tolerant of alkali soil. Cult. Calif.

2BT Eucalyptus resinifera. Kino Eucalyptus. Red-Mahogany. Tree. Australia. Cult. Calif.

2BT Eucalyptus Risdonii. Ornamental tree 20–50 ft. Australia. Cult. Calif.

2BT Eucalyptus robusta. Swamp-Mahogany. Tree. Australia. Cult. Fla. and Calif. Succeeds in alkali soil.

2B Eucalyptus rostrata. Red Gum. Tree to 200 ft. Australia. Cult. Fla. and Calif. Resists drought and alkali soil.

2BT Eucalyptus rudis. Desert Gum. Tree to 100 ft. Australia. Cult. Fla. and Calif.

2B Eucalyptus tereticornis. Forest Gray Gum, Flooded Gum. Australia. Cult. Fla. and Calif.

2BT Eucalyptus viminalis. Manna Gum. Tree to 300 ft. Australia. Cult. Calif.

2B Eugenia apiculata. Shrub to 8 ft. Chile. Cult. Calif.

2B Eugenia Jambos. Rose-Apple. Tree 20–30 ft. E. Indies. Cult. Fla. and Calif.

2BT Eugenia myrtifolia (E. australis. Jambosa myrtifolia). Australia Brush-Cherry. Tree to 80 ft. Cult. Calif.

Eugenia Ugni. See Myrtus Ugni.

1BS Euonymus Bungeana var. semipersistens (E. Hamiltoniana var. semipersistens. Also E. Sieboldiana, Hort.). Shrub to 15 ft. China, Manchuria.

2B Euonymus japonica. Shrub to 8 ft. S. Japan. Cult. South and W. coast to Wash.

1BR Euonymus nana. Low shrub 1–2 ft, arching branches, leaves bronze in winter. W. Asia to W. China.

1BR Euonymus nana var. Koopmannii. Leaves larger and broader than the type, bronzing in winter.

1B Euonymus radicans. Climbing Euonymus or Evergreen Bittersweet. Vine for brick and stone or creeping and shrubby to 3 ft. N. and cent. Japan. Cult. South and W. coast. Many varieties, especially acutus, Carrierei, minima (kewensis), and vegeta. Var. acutus is a new creeping form, foliage normal like the type but growth always low and flat, possible substitute for Vinca minor as ground-cover in the sun.

Evergreen Bittersweet. See Euonymus radicans.

Everlasting Thorn. See Pyracantha coccinea.

Evonymus. See Euonymus.

False China Brier. See Smilax laurifolia.

2B Fatsia japonica (Aralia japonica). Shrub or small tree. Japan, China. Cult. Calif.

2B Feijoa Sellowiana. Pineapple Guava. Shrub to 15 ft. S. Brazil to Argentina. Commonly cult. in Calif.

Fern-Palm. See Cycas circinalis.

Fetter-Bush. See Pieris lucida.

2B Ficus pumila (F. repens). Creeping Fig. Creeping vine for brick and stone. Japan, China, and Australia. Cult. South and Calif.

Also various other species of Ficus.

Fig. See Ficus.

Fir. See Abies.

Fire Thorn. See Pyracantha coccinea.

Flame-Flower. See Pyrostegia venusta.

2BT Fortunella japonica (Citrus japonica). Round Kumquat. Much-branched shrub. Cult. South and Calif.

Fortunes Palm. See Trachycarpus excelsa (T. Fortunei).

Foxberry. See Vaccinium Vitis-Idæa.
Fragrant Honeysuckle. See Lonicera fragrantissima.
Furze. See Ulex europæus.

2B Gardenia jasminoides (G. florida. G. radicans). Cape Jasmine. Very small shrub. China. Cult. South.
2B Gardenia jasminoides var. Fortuniana (G. Fortunei, Hort.). Shrub. Cult. South.
Garland-Flower. See Daphne.
2B Garrya elliptica. Shrub to 8 ft. Calif. to N. Mex.
2B Garrya Fremontii. Shrub to 10 ft. Ore. to Calif.
1BR Gaultheria procumbens. Wintergreen. Checkerberry. Creeping shrub to 5 in. Canada to Ga. west to Mich.
2BT Gaultheria Shallon. Spreading shrub to 2 ft. Brit. Col. to Calif.
2B Gaultheria Veitchiana. Spreading shrub to 3 ft. W. China.
1BR Gaylussacia brachycera. Box Huckleberry. Low shrub with creeping and ascending stems. Wooded hills, Pa. to Del. and Va.
2B Gelsemium sempervirens. Carolina Yellow Jessamine. Twining Vine. Va. to Fla., Tex., and Guatemala. Cult. South and Calif.
Genista of florists. See Cytisus canariensis.
Genista juncea. See Spartium.
2BR Genista tinctoria (G. sibirica, Hort. G. polygalæfolia, Hort.). Woodwax. Dyers Greenweed. Erect shrub to 3 ft. Eu., W. Asia. Deciduous and hardy North.
Golden Dewdrop. See Duranta repens.
Gold-Flower. See Hypericum Moserianum.
2B Gordonia Lasianthus. Loblolly Bay. Red Bay. Tree to 60 ft. Va. to Fla. and Miss. Cult. South.
Gorse. See Ulex europæus.
Grapefruit. See Citrus grandis.
Grapevine, Evergreen. See Cissus capensis.
2BT Grevillea robusta. Silk-Oak. Large tree from Australia. Cult. S. Fla. and Calif.
2BT Grevillea Thelemanniana (G. Preissii). Shrub to 4 ft. Australia. Cult. Calif.
Ground-Hemlock. See Taxus canadensis.
Ground-Pine. See Lycopodium.
Groundsel-Tree. See Baccharis halimifolium.
Guava. See Psidium Guajava.
Guava, Chilean. See Myrtus Ugni.
Guava, Strawberry. See Psidium Cattleianum.
Gum, Blue, Red, Sugar, etc. See Eucalyptus.

2BT Hakea elliptica. Shrub to 10 ft. Australia. Cult. Calif.
2BT Hakea laurina (H. eucalyptoides). Sea Urchin. Shrub to 15 ft. Australia. Cult. Calif.
2BT Hakea saligna. Shrub to 8 ft. Australia. Cult. Calif.
2BT Hakea suaveolens (H. pectinata). Shrub to 10 ft. Australia. Cult. Calif.
Halls Honeysuckle. See Lonicera japonica var. Halliana.
2BT Hamelia patens. Scarlet Bush. Shrub to 5–12 ft., becomes woody with age. S. Fla. to Brazil. Rarely killed down by frosts in Fla.
Harrimanella. See Cassiope.
Heath, Cornish, Scotch, and Pink Moor. See Erica.
Heath, Irish. See Dabœcia.

Heath, Spanish. See Erica lusitanica.
Heather. See Calluna vulgaris.
Heather, Bell. See Erica Tetralix.
Heather, Southern. See Ceratiola ericoides.

2B Hedera canariensis (H. Helix var. canariensis. H. azorica, Hort.). Vine climbing by root-like holdfasts. Canary Isls., Maderia, N. Afr. Cult. South.

2B Hedera colchica (H. Rægneriana, Hort.). Vine climbing by root-like holdfasts. Asia Minor, Caucasus, Persia. Cult. South.

1BP Hedera Helix. English Ivy. Vine for brick and stone climbing by root-like holdfasts. Eu., Canaries, N. Afr., Asia. Always safer with winter shade and best when used as ground-cover in the North. Cult. South and N. W. coast.

Heeria rosea. See Heterocentron roseum.

1B Helianthemum Chamæcistus (H. vulgare). Rock-Rose. Low procumbent subshrub. Eu., W. Asia, N. Afr.

2B Helianthemum ocymoides (H. algarvense. Cistus algarvense). Nearly erect twiggy shrub to 2–3 ft. Spain and Portugal.

Hemlock. See Tsuga.

2BT Heterocentron roseum (Heeria rosea). Shrub to 1 ft. Mex. and Cent. Amer.

2B Heteromeles arbutifolia (Photinia arbutifolia). Toyon. Christmas-Berry. Shrub or tree to 20 ft. Calif., also cult. South.

Heteromeles glabra. See Photinia glabra.
Heteromeles serrulata. See Photinia serrulata.

2BT Hibiscus heterophyllus. Tall shrub. Australia. Cult. South.

2BT Hibiscus Rosa-sinensis. Chinese Hibiscus. Tall shrub. Australia. Cult. South.

1BS Hippophaë rhamnoides. Sea Buckthorn. Large shrub or small tree from W. and cent. Asia, W. China or N. W. Himalayas. Remains low and shrubby in seashore planting.

Holly, American. See Ilex opaca.
Holly, English. See Ilex Aquifolium.
Holly, Japanese. See Ilex crenata.
Honeysuckle, Fragrant. See Lonicera fragrantissima.
Honeysuckle, Halls. See Lonicera japonica var. Halliana.
Honeysuckle, Japanese. See Lonicera japonica.
Honeysuckle, Trumpet. See Lonicera sempervirens.
Horse-Sugar. See Symplocos tinctoria.

2BT Hoya carnosa (H. Motoskei). Wax-Plant. Twining vine to 5–8 ft. S. China, Australia. Cult. Calif.

Huckleberry, Box. See Gaylussacia brachycera.

2BT Hymenosporum flavum. Pyramidal shrub or tree to 50 ft. Australia. Used on streets in Calif.

1BPRS Hypericum calycinum. Rose-of-Sharon. Aarons Beard. Spreads rapidly. Subshrub to 1 ft. Cult. South and W. coast to Wash.

2BS Hypericum hircinum. Compact subshrub to 2–3 ft. Medit. region. Cult. South and Calif.

2BS Hypericum Moserianum. Gold-Flower. Erect subshrub to 2 ft. A hybrid by Moser of France between H. patulum and H. calycinum. Cult. South and Calif.

2BS Hypericum patulum var. Henryi. Spreading shrub to 1½–3 ft. China. Cult. South and Calif.

1B Iberis sempervirens. Evergreen Candytuft. Perennial to 1 ft. S. Eu. Cult. South and N. W. coast.
1B Iberis Tenoreana. Perennial half shrubby to 6 in. Naples.
2B Ilex Aquifolium in variety, especially var. microphylla. English Holly. Tree to 40 ft. S. and cent. Eu., W. Asia, and China. Cult. South and N. W. coast.
2B Ilex Cassine (I. Dahoon). Dahoon. Shrub or small tree. N. C. to Fla. west to La. Cult. South.
2B Ilex cornuta. Shrubby tree. China. Cult. South.
1BPR Ilex crenata (I. Fortunei, Hort.). Japanese Holly. Much-branched shrub or small tree to 10 ft. Japan. Cult. South and N. W. coast.
1BPR Ilex crenata microphylla. Hardy at Cornell and Rochester. This is hardiest form of I. crenata.
1BPR Ilex glabra. Inkberry. Slender-branched upright shrub to 8 ft. Mass. to Fla., west to Miss.
2B Ilex integra (Othera japonica). Shrub or tree to 40 ft. Japan. Cult. South.
1BP Ilex opaca (I. quercifolia). American Holly. Tree to 50 ft. Mass. to Fla. west to Mo. and Tex.

Native on Cape Cod and also growing cheerfully in gravelly soil at Cornell and Rochester. In both places it is somewhat sheltered from northern winds, but has full exposure to winter sun. Also cult. N. W. coast.

2B Ilex Pernyi. Handsome compact shrub to 10 ft.
2B Ilex vomitoria (I. Cassine, Walt.). Cassena. Yaupon. Shrub rarely tree to 25 ft. Va. to Fla. west to Ark. and Tex.
2B Illicium anisatum (I. religiosum). Small tree. Japan. Hardier than Camellia.
2B Illicium floridanum. Shrub to 6–10 ft. Fla. to La.
2B Illicium parviflorum. Shrub lower than I. floridanum. Fla. to Ga.
Indian Hawthorn. See Raphiolepis indica.
Inkberry. See Ilex glabra.
Inodes. See Sabal.
2BT Iochroma grandiflorum (I. Warscewiczii). Shrub 10 ft. Ecuador. Cult. Calif.
Ironbark. See Eucalyptus.
Islands, Cherry. See Prunus Lyonii.
Ivy, English. See Hedera Helix.

Jambosa myrtifolia. See Eugenia myrtifolia.
Japanese Honeysuckle. See Lonicera japonica.
Japanese Oleaster. See Elæagnus umbellata.
Japanese Pittosporum. See Pittosporum Tobira.
Jasmine, Arabian. See Jasminum Sambac.
Jasmine, Cape. See Gardenia jasminoides.
Jasmine or Jessamine, Carolina Yellow. See Gelsemium sempervirens.
Jasmine, Italian, Royal, or Spanish. See Jasminum grandiflorum.
Jasmine, Red Coral. See Cestrum elegans.
Jasmine, Star or Confederate. See Trachelospermum jasminoides.
2BS Jasminum floridum. Erect shrub. China. Cult. South and Calif.
2B Jasminum fruticans. Bush to 12 ft. S. Eu., N. Afr. Cult. South and Calif.
2BT Jasminum grandiflorum. Italian, Royal, or Spanish Jasmine. Shrubby vine from India naturalized in Fla. Also cult. in Calif.
2BS Jasminum humile (J. triumphans, Hort.). Shrub to 20 ft. Trop. Asia. Cult. South and N. W. coast.

2BS Jasminum primulinum. Semi-evergreen South and cult. there and on N. W. coast.

2B Jasminum Sambac var. Grand Duke. Arabian Jasmine. Climbing vine. India. Cult. Calif.

Jerusulem-Thorn. See Parkinsonia aculeata.

Jessamine. See Jasmine.

2BT Jubæa spectabilis. Wine Palm of Chile. Cult. in S. Calif.

Juniper, Chinese. See Juniperus chinensis.

Juniper, Common. See Juniperus communis.

Juniper, Savin. See Juniperus Sabina.

Juniper, Trailing. See Juniperus horizontalis.

Juniper, others. See Juniperus.

Juniperus australis. See J. lucayana.

Juniperus barbadensis. See J. lucayana.

2 Juniperus californica. Tree to 40 ft. or shrubby in the mts. Calif.

Juniperus californica var. utahensis. See J. utahensis.

1 Juniperus chinensis (J. sinensis, Hort.) in variety. Chinese Juniper or Cedar. especially the following:

1 Juniperus chinensis var. Pfitzeriana. Wide flaring shrub 6 ft. high and 10 ft. wide, with nodding branchlets making a broad loose foliage mass.

1 Juniperus chinensis var. stricta. Slow growing, dense, conical shrub to 6–8 ft. high.

1R Juniperus chinensis var. Sargentii. This is still new in the trade, introduced from Japan by Sargent in 1892 and confused with another Sargent introduction now known as J. procumbens. Both J. chinensis var. Sargentii and J. procumbens have been distributed as J. chinensis var. procumbens which name is no longer correct. See J. procumbens and J. squamata.

The type and its varieties are cult. South and W. coast.

1 Juniperus communis. Common Juniper. Low-spreading shrub or small tree according to variety. Arctic N. Amer., Rockies, cent. Eu., N. Asia. Cult. South and W. coast. Many varieties especially:

1 Juniperus communis depressa (J. canadensis). Spreading variety, forming broad patches 1–3 feet high.

1 Juniperus communis hibernica (stricta, Carr.). Irish Juniper. Narrow columnar form to 15 ft.

1 Juniperus communis suecica (fastigiata, Hort.). Swedish Juniper. Narrow columnar form; habit a little looser than in hibernica and tips of branches more nodding.

1 Juniperus horizontalis (J. Sabina var. prostrata). Low spreading shrub with long prostrate branches and upright branchlets 1–2 ft. high. Nova Scotia to Brit. Col. south to N. Y., Minn. and Mont. Cult. South and W. coast.

1 Juniperus horizontalis var. Douglasii. Waukegan Juniper. A distinctly trailing form with bluish foliage especially in winter.

1R Juniperus japonica, Carr. This should now be called Juniperus chinensis var. japonica, Vilm. It is a dwarf shrub with foliage mostly of the juvenile type, i.e. awl-like and more or less spreading rather than scale-like and tightly overlapping. It has been distributed under the name Juniperus chinensis var. procumbens and occurs in two forms both of which have the young growth yellowish or golden. See Standard Cycl. Hort., p. 3569.

2 Juniperus lucayana (J. australis. J. barbadensis). Southern Red-Cedar. Tree to 50 ft. S. Ga. to Fla. Cult. Gulf States, W. Indies and Calif.

2 Juniperus occidentalis. Shrub with many upright branches or pyramidal tree to 40 ft. Wash. to Calif.

1R Juniperus procumbens. This has been confused with J. chinensis Sargentii, but most closely resembles the older Juniperus squamata.

1 Juniperus Sabina in variety especially:

1R Juniperus Sabina plumosa. This is a new seedling form recently introduced by Andorra Nurseries from the Maine coast. It is a lower, more spreading shrub with plumose foliage, i.e., the leaves are more acicular and spreading than in the type. The plant assumes a beautiful bronze color in winter. The type and its varieties are cult. South and W. coast.

1 Juniperus Sabina tamariscifolia (J. sabinoides). Procumbent or ascending shrub. Mts. of S. Eu.

1R Juniperus scopulorum. Similar to J. virginiana. Brit. Col. to Calif. in the Rocky Mts.

1 Juniperus squamata (J. recurva var. densa, Hort.). Closely allied to J. procumbens. Decumbent shrub. Himalayas, W. China.

Juniperus tamariscifolia. See J. Sabina tamariscifolia.

2 Juniperus thurifera. Shrub or tree to 40 ft. Spain, Algeria. Cult. South.

2 Juniperus utahensis (J. californica var. utahensis). Bushy tree, rarely over 20 ft. Colo. to Calif. and west to Utah.

1 Juniperus virginiana. Red-Cedar. Savin. Tree to 100 ft. Canada to Fla. east of the Rockies. Many varieties especially: Canaertii, compact dark green. Glauca, bluish foliage. Globosa, compact, globose form. Kosteriana, wide-spreading bush with almost horizontal branches; resembles J. chinensis var. Pfitzeriana but lower and foliage not so loose and pendulous. Schottii, dwarf pyramidal. Tripartita, dwarf spreading.

Jupiters Beard. See Anthyllis Barba-Jovis.

2B Kadsura japonica. Small, procumbent shrub. Japan. Cult. South.

1B Kalmia angustifolia. Sheep Laurel. Lambkill. Shrub to 3 ft. Newf. and Hudson Bay to Ga.

1BR Kalmia polifolia (K. glauca). Pale or Swamp Laurel. Small shrub 1–2 ft. Cold bogs and mts. Lab. to Alaska south to N. J., Pa., Mich., Minn., Calif.

1B Kalmia latifolia. American or Mountain Laurel. Shrub usually 3–8 ft., sometimes larger. New Bruns. to Fla. west to Ohio and Tenn. Best broad-leaved evergreen shrub for the Northeast, but requires an acid soil like azaleas and rhododendrons.

Kangaroo-Thorn. See Acacia armata.

Kangaroo-Vine. See Cissus antarctica.

Karo. See Pittosporum crassifolium.

Kei-Apple. See Dovyalis caffra.

King Orange. See Citrus nobilis.

Kumquat. See Fortunella (Citrus) japonica.

Labrador-Tea. See Ledum grœnlandicum.

2B Lagunaria Patersonii. Tree to 50 ft. Australia. Cult. Calif.

Lambkill. See Kalmia angustifolia.

2BT Latania borbonica. This is a common trade name among palms, but seeds offered under this name are usually Livistona chinensis which see below.

Laurel, California. See Umbellularia californica.

Laurel, Cherry. See Prunus Laurocerasus.

Laurel, English. See Prunus Laurocerasus.

Laurel, Great. See Rhododendron maximum.
Laurel, Magnolia. See Magnolia glauca.
Laurel, Mountain. See Kalmia latifolia.
Laurel, New Zealand. See Corynocarpus laevigata.
Laurel, Pale. See Kalmia polifolia.
Laurel, Portugal. See Prunus lusitanica.
Laurel, Sheep. See Kalmia angustifolia.
Laurel, Swamp. See Kalmia polifolia.
Laurocerasus. See Prunus.

2B Laurus nobilis. Sweet Bay. Small tree 40–60 ft. Medit. region. Cult. South.

2B Laurus nobilis var. regalis. This is a crimped-leaved form.

Laurustinus. See Viburnum Tinus.

2B Lavandula vera (L. angustifolia). Lavender. Subshrub to 1–3 ft. Canary Isls. to India. Cult. South.

2BT Lavatera assurgentiflora. Shrub 6–15 ft. S. Calif. isls. Drought resistant.

Lavender. See Lavandula vera.
Lavender-Cotton. See Santolina Chamæcyparissus.
Lawson Cypress. See Chamæcyparis Lawsoniana.
Leatherwood. See Cyrilla racemiflora.
Ledum buxifolium. See Leiophyllum buxifolium.

1BR Ledum grœnlandicum (L. latifolium, Ait.). Labrador-Tea. Shrub to 1–3 ft. Canada, Brit. Col. south to Pa. and Wis.

1BR Leiophyllum buxifolium (Dendrium and Ledum buxifolium). Sand-Myrtle. Dense, leafy bush to 3 ft. Pine-barrens and mts. N. J. to Fla.

1BR Leiophyllum buxifolium var. prostratum. Low form making a dense tuft.

Lemon (Citrus Limonia) is more sensitive to cold than the orange and is grown only in southern Fla. and the southern coast of Calif. It is not included in this list.

2B Leptospermum lævigatum. Shrub to 10 ft. Australia. Cult. Calif.

2B Leptospermum scoparium, in variety. Shrub to 4–8 ft. New Zeal. Cult. Calif.

2B Leucophyllum texanum. Spreading shrub to 8 ft. Tex., New Mex.

1BPR Leucothoë axillaris (Andromeda axillaris). Shrub to 5 ft. Va. to Fla. and Ala. Best in partial shade.

1BPR Leucothoë Catesbæi (Andromeda Catesbæi). Shrub to 6 ft. Va. to Ga. Best in partial shade.

2B Leucothoë populifolia (L. acuminata. Andromeda acuminata). Shrub to 12 ft. S. C. to Fla.

1BS Leucothoë racemosa (Andromeda racemosa). Shrub to 10 ft. Mass. to Fla. and La.

2 Libocedrus chilensis. Tree to 60 ft. Chile.

2 Libocedrus decurrens (L. Craigana. Thuja Craigana and gigantica). White Cedar. Tree to 100 ft. sometimes more. Ore. to Calif. and W. Nev. Cult. South.

2B Ligustrum amurense (L. Ibota var. amurense). Amur River Privet. Shrub to 15 ft. This should be semi-evergreen in the South, but is deciduous North where it has proved to be the most hardy of all privets. Japan, China.

2B Ligustrum coriaceum (L. lucidulum). Dwarf dense shrub to 6 ft. Cult. from Japan and in the South and N. W. coast.

Ligustrum Ibota var. amurense. See L. amurense.

2B Ligustrum japonicum (L. syringæflorum, Hort.). Shrub to 10 ft. Japan. Cult. South and N. W. coast.

2B Ligustrum lucidum (L. spicatum, Hort.). Large shrub or tree to 20 ft. Japan, China. Cult. South and Calif.

2B Ligustrum nepalense (L. spicatum). Shrub or tree. Himalayas. Cult. South and Calif.

1BPS Ligustrum ovalifolium (L. californicum, Hort. L. japonicum, Hort.). California Privet. Shrub to 15 ft. Japan. Cult. and semi-evergreen South and W. coast to Wash.

1BPR Ligustrum Prattii (L. Delavayanum). Low spreading shrub. W. China.

2B Ligustrum Quihoui (L. brachystachyum). Shrub to 6 ft. China. Semi-evergreen and cult. South and Calif.

2BS Ligustrum sinense (L. Fortunei, Hort.). Shrub to 8 ft. China, Korea. Semi-evergreen and cult. South and Calif., where it becomes tree-like to 30 ft. This is sometimes confused with L. amurense in the trade.

2B Ligustrum vulgare. Common, English or European Privet. Shrub to 15 ft. Eu., N. Afr., W. Asia. This should be semi-evergreen South. It resembles L. ovalifolium, but is more hardy and fully deciduous North.

Lime (Citrus aurantifolia) is the most tender of the citrus fruits. In the U. S. it is cult. only below the frost line, mostly in the Fla. Keys and a little in S. Calif. It is not included in this list.

Ling. See Calluna vulgaris.

1BR Linnæa borealis. Twin-flower. Trailing subshrub with slender stems. In moist mossy woods and cold bogs Canada and south to mts. of Pa., Md., and Mich.

2BT Livistona australis (Corypha australis). Palm. Stem 40–80 ft. Australia. Cult. Fla.

2BT Livistona chinensis (Latania borbonica, Hort.). Palm. Stem to 6 ft. China. Cult. Fla.

Loblolly Bay. See Gordonia Lasianthus.

1R Loiseleuria procumbens (Chamæcistus procumbens. Azalea procumbens). Alpine Azalea. Procumbent shrub only a few inches high. Sub-arctic regions of northern hemisphere.

1BPS Lonicera fragrantissima (L. caprifolioides. L. Caprifolium Niaguarilli, Hort.). Fragrant Honeysuckle. Shrub to 8 ft. China. Cult. South.

1BPRS Lonicera Henryi. Twining vine. W. China.

2B Lonicera Hildebrandiana. Climbing shrub. Upper Burma. Cult. Calif.

1BPS Lonicera japonica. Japanese Honeysuckle. Twining vine. Asia. Naturalized Conn. to Fla.

1BPS Lonicera japonica var. Halliana. Halls Honeysuckle. Twining vine. China and Japan. Naturalized from N. Y. to N. C. and cult. South and W. coast to Wash.

2B Lonicera nitida. Shrub to 6 ft. W. China. Cult. Calif. and South.

1BPR Lonicera pileata. Low spreading shrub, sometimes prostrate. Cent. and W. China. Cult. South.

2BS Lonicera sempervirens (Caprifolium sempervirens). Trumpet Honeysuckle. Twining vine. Conn. to Fla., west to Neb. and Tex. Farther north sometimes escaped from cult.

1BPRS Lonicera similis var. Delavayi. Allied to L. japonica. Cent. and W. China.

1BPS Lonicera Standishii (L. sinensis, Hort. L. Fortunei, Hort.). Shrub to 6 ft. China.

Lophostemon arborescens. See Tristania conferta.

Loquat. See Eriobotrya japonica (Photinia japonica).

2BT Lotus Berthelotii (L. peliorhynchus). Coral Gem. Slender vine. Cape Verde, Canaries. Cult. Calif.

2BS Lycium chinense. Chinese Matrimony-Vine. Shrub to 6 ft. China. Deciduous North, but should be nearly evergreen South. Larger in every part, but not quite so hardy as L. halimifolium. Cult. Calif.

2BS Lycium halimifolium (L. vulgare). Matrimony-Vine. Shrub with long slender branches. Deciduous North but should be semi-evergreen South. Arching shrub much used as a vine. China, S. E. Eu.

1 Lycopodium annotinum. Stems trailing to several feet, ascending branches 6–8 in. Arctic and north temp. zones.

1 Lycopodium clavatum. Club Moss. Main stem trailing to several feet. Arctic and north temp. zones.

1 Lycopodium complanatum. Christmas Green. Stems trailing, branches horizontal. Northern hemisphere.

1 Lycopodium lucidulum. Stems erect to 12 inches. Lowlands of northern hemisphere.

1 Lycopodium obscurum (L. dendroideum). Ground-Pine. Much branched stems 6–12 inches. Temp. N. Amer., Japan.

2B Lyonia ferruginea (Andromeda and Xolisma ferruginea). Shrub or small tree. S. C. to Fla.

Lyonia nitida. See Pieris lucida.

2B Lyonothamnus floribundus var. asplenifolius. Shrubby to 20 ft. Islands off Calif. coast.

Macartney Rose. See Rosa bracteata.

Madrona. See Arbutus Menziesii.

2B Magnolia Delavayi. Shrub or tree to 30 ft. W. China.

Magnolia fuscata. See Michelia fuscata.

2B Magnolia glauca (M. virginiana). Sweet Bay. Laurel Magnolia. Shrub or small tree. Deciduous North, semi-evergreen South. Mass. to Fla. near coast in the South extending west to Tex.

2B Magnolia grandiflora (M. fœtida). Bull Bay. Tree to 80 ft. N. C. to Tex. Cult. South.

1BP Mahonia Aquifolium (Berberis Aquifolium). Oregon-Grape. Holly-leaved Mahonia. Shrub to 3–6 ft. Brit. Col. to Ore. Cult. South.

1BP Mahonia japonica (Berberis japonica. B. Bealii). Japan Mahonia. Shrub to 5–12 ft. China, Himalayas and cult. in Japan. Cult. South and Calif.

2B Mahonia nepalensis (Berberis nepalensis). Shrub to 5–12 ft. India, chiefly Himalayas. Cult. Calif.

1BPR Mahonia nervosa (Berberis nervosa). Ash Mahonia. Dwarf shrub 1 ft. Brit. Col. to Calif.

2B Mahonia pinnata (M. fascicularis. Berberis pinnata). Shrub to 2–6 ft. Calif., N. Mex. and Mex. Cult. South.

1BR Mahonia repens (Berberis repens). Trailing Mahonia. Rarely over 1 ft. Brit. Col. to Calif. and N. Mex. Hardiest Mahonia. Cult. South.

2B Mahonia trifoliolata (Berberis trifoliata). Shrub 5–12 ft. Tex. to Mex.

2BT Malvaviscus arboreus (Achania Malvaviscus). Tall shrub. S. Amer. Cult. South.

2BT Malvaviscus mollis (Achania mollis). Shrub to 6 ft. Mex. to Colombia. Cult. Calif.

Mandarin Orange. See Citrus nobilis var. deliciosa.

2B Manettia bicolor. Twining vine. Brazil. Cult. South and Calif.

Matrimony-Vine. See Lycium halimifolium.

Mayflower. See Epigæa repens.

Maypop. See Passiflora incarnata.
Mayten. See Maytenus Boaria.

2BT Maytenus Boaria (M. chilensis). Mayten. Large tree. Chile. Cult. in Calif. as small tree to 15–25 ft.

2B Medicago arborea. Tree Alfalfa. Shrub to 6 ft. S. Eu. Cult. Calif.

2B Melaleuca decussata. Shrub to 10 ft. Australia. Cult. Calif.

2B Melaleuca ericifolia. Small tree. Australia. Cult. Calif.

2B Melaleuca hypericifolia (M. oppositifolia, Hort.). Tall shrub. Australia. Cult. Calif.

2B Melaleuca Wilsonii. Tall elegant shrub. Australia. Cult. Calif.

Memorial Rose. See Rosa Wichuraiana.
Menziesia. See Dabœcia and Phyllodoce.
Menziesia cærulea. See Phyllodoce.
Mespilus Pyracantha. See Pyracantha coccinea.

2B Metrosideros lucida. Mountain Rata. New Zeal. tree. Cult. in Calif. as shrub to 6 ft.

2B Metrosideros robusta. New Zeal. tree. Cult. in Calif. as shrub to 8 ft.

2B Metrosideros semperflorens. See Callistemon lanceolatus.

2B Metrosideros tomentosa. Christmas-Tree of New Zeal. and tree to 70 ft. New Zeal. Cult. Calif.

2B Michelia fuscata (Magnolia fuscata). Banana-Shrub. Shrub 10–15 ft. China. Cult. South and N. W. coast.

2B Millettia megasperma. Evergreen Wisteria. Woody climber from Australia. Cult. Calif.

Mirasolia diversifolia. See Tithonia diversifolia.
Mistletoe, American. See Phoradendron flavescens.

1B Mitchella repens. Partridge-Berry. Creeping vine. Nova Scotia to Minn., south to Fla. and Mex. Useful in half-shaded spots.

Mock-Orange. See Pittosporum undulatum.
Monkey-Puzzle. See Araucaria araucana.
Morella. See Myrica.
Mother of Thyme. See Thymus Serpyllum.
Mountain Cranberry. See Vaccinium Vitis-Idæa.
Mountain-Holly. See Prunus ilicifolia.
Mountain-Mahogany. See Cercocarpus parvifolium.
Mountain Rata. See Metrosideros lucida.
Mountain Rose Bay. See Rhododendron catawbiense.

2B Muehlenbeckia complexa. Wire-Plant. Twining shrubby climber. New Zeal. Cult. in Calif.

Myginda myrtifolia. See Pachistima Myrsinites.

2B Myoporum laetum (M. perforatum, Hort.). Shrub to 12 ft. New Zeal. Cult. Calif.

2B Myrica californica. Slender tree to 40 ft. Wash. to Calif. Cult. Calif.

2BS Myrica carolinensis (Morella carolinensis). Bayberry. Shrub 2–8 ft. Nova Scotia to Fla. and Ala. Deciduous and hardy North.

2BS Myrica cerifera (Morella cerifera). Wax-Myrtle. Slender tree to 40 ft. Md. to Fla., Tex. and Ark.

Myrtle. See Myrtus and Vinca minor.
Myrtle, Sand. See Leiophyllum buxifolium.

2B Myrtus communis, in variety. Myrtle. Shrub 3–5 ft. Azores, Beluchistan. Cult. South and Calif.

2BT Myrtus Ugni (Eugenia Ugni). Ugni, or Chilean Guava. Tree from Chile, but remaining shrubby to 4 ft. as cult. in Calif.

2B Nandina domestica. Shrub to 8 ft. Japan, China. Cult. South and Calif.
2BT Nannorhops Ritchieana. Tufted, small, fan-leaved palm. Shade. Afghanistan and India. Rare in cult.
Natal-Plum. See Carissa grandiflora.
Needle Palm. See Rhapidiphyllum hystrix.
Neowashingtonia Sonoræ. See Washingtonia Sonoræ.
2B Nerium Oleander. (N. lauriforme), in variety. Oleander. Rose Bay. Shrub to 7–15 ft. Medit. region, Orient. Cult. South and Calif.
Nutmeg, California-. See Torreya californica.

Oak, California Live. See Quercus chrysolepsis.
Oak, Cork. See Quercus Suber.
Oak, Holly or Holm. See Quercus Ilex.
Oak, Laurel. See Quercus laurifolia.
Oak, Live. See Quercus virginiana.
Olea americana, Aquifolium, and fragrans. See Osmanthus.
2BT Olea chrysophylla. Small tree. Trop. Afr.
2BT Olea europæa (O. gallica, O. sativa). Olive. Small tree to 15–20 ft. E. Medit. region or W. Asia. Cult. Calif.
Oleander. See Nerium Oleander.
Oleaster, Japanese. See Elæagnus umbellata.
Olive. See Olea europæa.
Olive, Spurge. See Cneorum tricoccon.
Orange, King. See Citrus nobilis.
Orange, Mandarin. See Citrus nobilis var. deliciosa.
Orange, Mexican. See Choisya ternata.
Orange, Sour or Seville. See Citrus Aurantium.
Orange, Sweet. See Citrus sinensis.
Oregon-Grape. See Mahonia Aquifolium.
Oreodaphne californica. See Umbellularia californica.
2BT Oreodoxa regia (Roystonea floridana). Royal Palm. 40–60 ft. Cuba, Antigua. Safe in lower third of Fla. and lives in S. Calif. but never attains much height.
2B Osmanthus americanus (Olea americana). Florida Olea. Devil-wood. Shrub or small tree to 40 ft. N. C. to Fla. and Miss. Cult. South and N. W. coast.
2B Osmanthus Aquifolium (Olea Aquifolium). Shrub or small tree to 20 ft. Japan. Cult. South and N. W. coast.
2B Osmanthus fragrans (Olea fragrans). Small tree to 30 ft. or a shrub. Himalayas, China, S. Japan. Cult. South and N. W. coast.
Othera japonica. See Ilex integra.
2BT Oxera pulchella. Greenhouse climber. New Caledonia.
Oxycoccus macrocarpus. See Vaccinium macrocarpon.

1BR Pachistima Canbyi. Very dwarf shrub to 6 inches. Mts. of Va. Somewhat similar to Euonymus nana.
1BPR Pachistima Myrsinites (Myginda myrtifolia). Spreading shrub to 2 ft. Brit. Col. to Calif. and N. Mex.
1B Pachysandra terminalis. Evergreen Spurge. Subshrub used as ground-cover. Japan. Cult. South.
Padus lusitanica. See Prunus lusitanica.
Palm, Blue. See Erythea armata and Sabal glabra.
Palm, Date. See Phœnix canariensis.

Palm, Dwarf Date. See Phœnix Roebelenii.
Palm, Fern-. See Cycas circinalis.
Palm, Pindo. See Arecastrum Romanzoffianum var. australe.
Palm, Royal. See Oreodoxa regia.
Palm, Silver. See Coccothrinax Garberi.
Palm, Spineless. See Sabal Blackburniana.
Palm, Wine. See Jubæa spectabilis.
Palmetto. See Rhapidophyllum, Sabal, Serenoa.
Palmetto, Blue. See Rhapidophyllum hystrix.
Palmetto, Cabbage. See Sabal Palmetto.
Palmetto, Dwarf. See Sabal glabra.
Palmetto, Saw. See Serenoa serrulata.
Palmetto, Scrub. See Sabal megacarpa.
Palms. See Archontophœnix, Brahea, Chamærops, Cocos, Erythea, Jubæa, Livistona, Nannorhops, Oreodoxa, Phœnix, Rhapidophyllum, Rhapis, Sabal, Serenoa, Trachycarpus, Trithrinax, Washingtonia.
Pandora. See Pandorea australis.

2BT Pandorea australis. Wonga-Wonga Vine. Pandora. Twining vine or shrub. Australia to Malay Archipelago and in S. Afr. Cult. in Calif.

2BT Pandorea jasminoides var. alba (Tecoma jasminoides. Bignonia jasminoides, Hort.). Bower-Plant of Australia. Climbing shrub. Australia to Malay Archipelago and in S. Afr. Cult. in Calif.

2B Parkinsonia aculeata. Jerusalem-Thorn. Small tree to 10 ft. Probably Trop. Amer. Cult. South and Calif.

Parrots Bill. See Clianthus puniceus.
Partridge-Berry. See Mitchella repens.
Passiflora ignea. See P. manicata.

2B Passiflora incarnata. Wild Passion-Flower. Maypop. Tall climbing vine in dry places. Va., South and West.

2BT Passiflora manicata (P. ignea, Hort. Tacsonia manicata). Red Passion-Vine. Tendril-climbing vine. Colombia, Ecuador and Peru. Cult. in S. Calif., renews itself from seed.

2B Passiflora militaris (Tacsonia militaris). Introduced from Transvaal.

2B Passiflora mollissima (Tacsonia mollissima). Tendril-climbing vine. Andes. Cult. in Calif.

2BT Passiflora tubiflora. Similar to P. mollisima. Andes. Cult. in Calif.

Passion-Flower, Wild. See Passiflora incarnata.
Passion-Vine, Red. See Passiflora manicata.
Pepper-Tree. See Schinus Molle.
Periwinkle. See Vinca minor and major.

2B Pernettya angustifolia (P. mucronata var. angustifolia). Shrub. Chile. Cult. South and W. coast.

2B Pernettya mucronata (Arbutus mucronatus). Shrub. Magellan region to Chile. Ornamental fruiting shrub in wintertime.

2BT Persea americana (P. gratissima). Avocado. Tree to 60 ft. Mex. and Cent. Amer.

2B Persea Borbonia (P. carolinensis). Red Bay. Bull Bay. Tree reaching 40 ft. N. C. to Fla. Cult. South.

Persea gratissima. See P. americana.

2B Persea palustris (P. pubescens. Tamala pubescens). Shrub or small tree. Swamps and hammocks, N. C. to Fla. and Tex.

Persea pubescens. See P. palustris.

Peruvian Mastic-Tree. See Schinus Molle.

2BT Phædranthus buccinatorius (Bignonia Cherere. B. Kerere, Hort.). Tendril-climbing vine. Mex. Cult. Calif.

2BT Philadelphus mexicanus (P. guatemalensis). Shrub to 6 ft. Mex. and probably Guatemala. Cult. Calif.

2B Phillyrea angustifolia. Spreading shrub to 15 ft. Medit. region. Cult. South.

2B Phillyrea decora (P. laurifolia). Shrub to 10 ft. W. Asia, S. Eu., N. Afr. Cult. South and Calif.

2B Phillyrea latifolia. Shrub to 10 ft. S. Eu., N. Afr. Cult. South and Calif.

2B Phillyrea media (P. latifolia var. media). Spreading shrub to 20 ft. Hardiest of all. Medit. region.

2BT Phœnix canariensis, Hort. (P. tenuis). Tall palm. Canary Isls. Cult. Fla. and Calif.

2RT Phœnix dactylifera (P. cycadifolia, Hort.). Date Palm. Tree to 100 ft Arabia, N. Afr. Alkali resistant. Cult. Fla. and Calif.

2BT Phœnix humilis. Sts. short. Hilly districts of India. Safer in shade.

2BT Phœnix reclinata (P. leonensis. P. zanzibarensis, Hort.). Stem to 25 ft. or more. Trop. S. Afr. Cult. Fla.

2BT Phœnix Roebelenii. Dwarf Date Palm. China. Safer in shade. Cult. Fla. and Calif.

2BT Phœnix rupicola (P. cycadifolia). Sikkim, Himalaya. Cult. Fla. and Calif.

2BT Phœnix sylvestris. Tree 25–40 ft. India. Cult. Fla. and Calif.

2B Phoradendron flavescens (Viscum flavescens). American Mistletoe. Dense bushy growth, parasitic on deciduous trees. N. J. and S. Ind. to Fla. and Tex.; also Calif.

Photinia arbutifolia. See Heteromeles arbutifolia.

2B Photinia glabra (Heteromeles, Cratægus and Sorbus glabra). Shrub to 8 ft. China and Japan. Cult. N. W. Coast.

Photinia japonica. See Eriobotrya japonica.

2B Photinia serrulata (Heteromeles serrulata). Shrub to 20 ft. China. Cult. South and Calif.

1R Phyllodoce cærulea (Bryanthus taxifolius. Menziesia cærulea). Alpine, heath-like shrub to 6 in. N. Asia, N. Eu., and boreal N. Amer.

1R Phyllodoce empetriformis (Bryanthus and Menziesia). Brit. Col. to Calif. Alpine heath-like shrub, 5–8 in.

2B Phyllostachys Henonis (Bambusa Henonis, Hort.). 10–15 ft. Japan.

Phyllostachys nitida. See Arundinaria nitida.

NOTE.—Few northern spruces can stand the summer heat of the South.

1 Picea Abies (P. excelsa). Norway Spruce. Tree to 150 ft. N. and Cent. Eu. Successful South only in favorable, cooler situations. Many varieties, especially:

Clanbrasiliana (Abies excelsa Clanbrasiliana). Broadly conical.

Gregoryana. Compact subglobose form.

Maxwellii. Low, flat, dense form.

pendula. With pendulous branches and branchlets.

Picea ajanensis. See P. jezoensis.

Picea alba. See P. glauca.

Picea Alcockiana. See P. bicolor.

1R Picea bicolor (P. Alcockiana). Tree 80–150 ft. Japan.

Picea canadensis. See P. glauca.

1 Picea Engelmanni (P. columbiana). Engelmann Spruce. Tree to 150 ft. Brit. Col. to Ariz. and N. Mex.

Picea excelsa. See P. Abies.

1 Picea glauca (P. alba and P. canadensis). White Spruce. Tree 60–70 ft. Lab. to Alaska south to Mont. and Minn.

2R Picea jezoensis (P. ajanensis). Tree 100–150 ft. E. Siberia to N. Japan. Rarely cult. East but successful in N. W.

1R Picea mariana (P. nigra). Black Spruce. Small tree usually 25–30 ft. Cold bogs and mt. slopes. Canada, south to the Great Lakes and N. J.

1R Picea mariana var. Doumetii. Dense conical pyramid.

Picea nigra. See P. mariana.

1R Picea Omorika. A very promising new spruce from S. E. Eu.

1P Picea orientalis. Oriental Spruce. Tree to 120 ft. W. Asia, Caucasus. Graceful slow-growing tree adapted to smaller scale plantings and easily restrained. Cult. South.

1PR Picea polita (P. Torano). Tigertail Spruce. Tree to 90 ft. Japan. Cult. South.

1 Picea pungens (P. Parryana). Colorado or Blue Spruce. 80–100 ft. Wyo. to Colo. and Utah. Very hardy tree.

1 Picea pungens var. Kosteriana. Koster Blue Spruce. This is the bluest form of the Colorado or blue spruce.

1R Picea rubra (P. australis). Red Spruce. Tree to 80 ft. Canada to N. C. along the Alleghany. Requires cool and moist situations.

Picea Torano. See P. polita.

1B Pieris (Andromeda) floribunda. Dense shrub to 3 ft. Va. to Ga. in the Alleghany Mts.

2B Pieris formosa (Andromeda formosa). Shrub or small tree to 20 ft. E. Himalayas. Cult. Fla.

1BP Pieris (Andromeda) japonica. Shrub to 6 ft., sometimes larger. Japan. Cult. South.

2B Pieris lucida (Andromeda nitida). Fetter-Bush. Shrub 2–6 ft. N. C. to Fla. and La.

2B Pieris ovalifolia (Andromeda ovalifolium). Half-evergreen or deciduous shrub or tree to 40 ft. Himalayas. Cult. Fla.

2B Pimelea ferruginea. Shrub to 3–5 ft. W. Australia. Cult. Calif.

Pine, Alleppo. See Pinus halepensis.

Pine, Australian. See Casuarina equisetifolia.

Pine, Austrian. See Pinus nigra var. austriaca.

Pinus, Bhotan. See Pinus excelsa.

Pine, Cluster. See Pinus Pinaster.

Pine, Digger or Bull. See Pinus Sabiniana.

Pine, Italian Stone. See Pinus Pinea.

Pine, Jack or Scrub. See Pinus Banksiana.

Pine, Japanese Black. See Pinus Thunbergii.

Pine, Japanese Red. See Pinus densiflora.

Pine, Jeffrey. See Pinus Jeffreyi.

Pine, Limber. See Pinus flexilis.

Pine, Loblolly. See Pinus Tæda.

Pine, Monterey. See Pinus radiata.

Pine, Mountain White. See Pinus monticola.

Pine, Mugo. See Pinus Mugo var. Mughus.

Pine, Nut. See Pinus cembroides var. Parryana.

Pine, Pitch. See Pinus rigida and Coulteri.

Pine, Prickle-cone. See Pinus muricata.

Pine, Red or Norway. See Pinus resinosa

Pine, Scotch. See Pinus sylvestris.
Pine, Scrub. See Pinus contorta.
Pine, Scrub or Jersey. See Pinus virginiana.
Pine, Southern or Long-leaf. See Pinus palustris.
Pine, Sugar. See Pinus Lambertiana.
Pine, Swiss Mountain. See Pinus Mugo.
Pine, Swiss Stone. See Pinus Cembra.
Pine, Umbrella-. See Sciadopitys verticillata.
Pine, White. See Pinus Strobus.
Pine, Yellow, Western or Bull. See Pinus ponderosa.
Pine, Yellow or Spruce. See Pinus echinata.
Pineapple Guava. See Feijoa Sellowiana.
Pinnon. See Pinus cembroides var. Parryana.
Pinus austriaca. See P. nigra var. austriaca.

1 Pinus Banksiana (P. divaricata). Jack Pine. Scrub Pine. Tree to 70 ft. Hudson Bay to N. Y., west to Minn.

2T Pinus canariensis. Tree to 80 ft. Canary Isls. Does well in dry rocky situations in Calif.

1 Pinus Cembra. Swiss Stone Pine. Tree to 70–120 ft. Cent. Eu.

2 Pinus cembroides var. Parryana (P. quadrifolia). Nut Pine. Pinnon. Tree to 40 ft. Calif.

2 Pinus contorta (P. Bolanderi. P. contorta var. Bolanderi). Scrub Pine. Tree 20–30 ft. Alaska to Calif.

2 Pinus Coulteri (P. macrocarpa). Pitch Pine. Tree to 80 ft. Calif.

1 Pinus densiflora. Japanese Red Pine. Tree to 100 ft. Japan. Cult. South.

1 Pinus densiflora var. umbraculifera. Tanyosho Pine.

Pinus divaricata. See P. Banksiana.

1 Pinus echinata (P. mitis). Yellow Pine. Spruce Pine. Tree 100–120 ft. N. Y. to Fla. west to Ill. and Tex. Hardy north to Mass.

1PR Pinus excelsa (P. nepalensis). Bhotan Pine. Tree 150 ft. Himalayas. Much cult. South.

NOTE.—Pinus excelsa is probably the most successful pine in the South, aside from the native species. Pinus sylvestris is also much planted but grows more slowly than in the North. P. Strobus and P. nigra var. austriaca and P. Mugo var. Mughus succeed where given favorable conditions.

1R Pinus flexilis. Limber Pine. Tree to 50 ft. Alberta to Calif. and New Mex. Hardy pine of slow growth.

2 Pinus halepensis (P. alepensis). Aleppo Pine. Tree to 60 ft. Medit. region. Good for seaside planting.

2 Pinus Jeffreyi (P. ponderosa var. Jeffreyi). Jeffrey Pine. Tree to 120 rarely 180 ft. Ore. to Calif., hardy north to Mass.

1R Pinus koraiensis (P. mandshurica). Pyramidal tree to 100 ft. Japan. Korea.

2 Pinus Lambertiana. Sugar Pine. Tree 200–220 ft. Ore. to Mex. Hardy north to Mass.

2R Pinus monophylla (P. Fremontiana). Tree 15–20 ft., occasionally 50 ft. Calif. to Colo. and Ariz. Hardy north to Mass.

Pinus montana. See P. Mugo.

Pinus montana var. Mughus. See P. Mugo var. Mughus.

1R Pinus monticola. Mountain White Pine. Tree to 100–150 ft. Brit. Col. to Idaho and Calif.

1 Pinus Mugo. Swiss Mountain Pine. Mts. of cent. Eu.

1 Pinus Mugo var. Mughus. Mugho Pine. Best shrubby pine in northern planting. Also cult. South under favorable conditions.
2 Pinus muricata. Prickle-cone Pine. Tree to 50 ft., occasionally 90 ft. Calif.
1 Pinus nigra var. austriaca. Austrian Pine. Tree to 100 ft. S. Eu. to W. Asia. Cult. South under favorable conditions.
2 Pinus palustris (P. australis). Long-leaf Pine. Southern Pine. Tree 100–120 ft. Va. to Fla. to Miss. along coast.
Pinus Parryana. See P. cembroides var. Parryana.
1R Pinus parviflora. Tree to 80 ft. Japan.
2 Pinus Pinaster (P. maritima). Cluster Pine. Tree to 100 ft. S. Eu. Cult. Calif.
2 Pinus Pinea. Italian Stone (Classic) Pine. Tree to 80 ft. S. Eu. Cult. Calif.
1R Pinus ponderosa (P. Benthamiana). Western Yellow Pine. Bull Pine. Tree to 150 ft. Brit. Col. to Mex. east to Nev. and Tex. Promising in the N. E. but still rare.
2 Pinus radiata (P. montereyensis). Monterey Pine. Tree to 80–100 ft. S. Calif. Good for seaside.
1 Pinus resinosa. Red or Norway Pine. Tree to 70 ft. Newf. to Man. south to Pa. and Minn.
1 Pinus rigida. Pitch Pine. Tree to 80 ft. New Bruns. to Ga., west to Ont. and Ky. Very picturesque when old.
2 Pinus Sabiniana. Digger or Bull Pine. Tree to 50 ft. Calif.
1 Pinus Strobus. White Pine. Tree to 100 ft. Newf. to Man. south to Ga., Ill. and Iowa. Commonest pine in northern plantings and cult. South under favorable conditions.
1 Pinus sylvestris. Scotch Pine. Tree to 70 ft. Eu. to W. and N. Asia. Cult. South but grows more slowly than in the North.
2 Pinus Tæda. Loblolly Pine. Large tree. Del. to Fla. and Tex.
1R Pinus Thunbergii (P. Massoniana). Japanese Black Pine. Tree to 120 ft.
1R Pinus virginiana (P. inops). Scrub Pine. Jersey Pine. Tree to 40 ft. N. Y. to S. C., west to Ky. and Ind. Hardy as far north as Mass.
Pipsissewa. See Chimaphila umbellata.
2BT Pithecoctenium cynanchoides (Bignonia alba, Hort.). Vine. Argentina, Uruguay. Cult. in Fla. and Calif.
2BT Pithecoctenium muricatum (Bignonia echinata). Shrub. Mex. Cult. in Calif.
2B Pittosporum crassifolium. Karo. Shrub or small tree to 20 ft. New Zeal. Cult. Calif.
2B Pittosporum eugenioides. Shrub or small tree to 10 ft. New Zeal. Cult. Calif.
2B Pittosporum heterophyllum. Half-reclining shrub to 3 ft. China. Cult. in Calif.
2B Pittosporum phillyræoides. Narrow-leaved Pittosporum. Small tree to 20 ft. Australian desert. Cult. Calif.
2BT Pittosporum rhombifolium. Queensland Pittosporum. Australian tree. Cult. in Calif. as shrub to 15 ft.
2B Pittosporum tenuifolium (P. nigricans, Hort.). Tawhiwhi. Large shrub from New Zeal. Cult. Calif. to 15 ft.
2B Pittosporum Tobira in variety. Japanese Pittosporum. Shrub to 10 ft. China, Japan. Cult. South and Calif.
2BT Pittosporum undulatum. Victorian-Box. Mock-Orange. Australian tree. Cult. in Fla. and Calif. as shrub to 15 ft.
2BT Pittosporum viridiflorum (P. sinense). Cape Pittosporum. Large shrub from S. Afr. Cult. in Calif. to 10 ft.

2BT Plumbago capensis var. alba. S. Afr. Cult. in Fla. and Calif. as shrubby vine to 4 ft.

2 Podocarpus alpina. Shrub or small tree to 15 ft. Australia. Rare in cult. Hardy to Phila.

Podocarpus koraiana. See Cephalotaxus drupacea var. fastigiata.

2 Podocarpus Totarra. Tree to 90 ft. New Zeal. Rare in cult.

2B Polygala Dalmaisiana (P. myrtifolia var. Dalmaisiana, Hort. Also P dalmacina). A free blooming shrub 3–5 ft., of garden origin. Cult. Calif.

Popinac. See Acacia Farnesiana.

1BR Potentilla tridentata. Three-toothed Cinquefoil. Ground-cover. N. E. N. Amer. Excellent but little-known plant for the rock-garden.

Princes Pine. See Chimaphila umbellata.

Privet, Amur River. See Ligustrum amurense.

Privet, California. See Ligustrum ovalifolium.

Privet, English, European or Common. See Ligustrum vulgare.

2B Prunus caroliniana (P. sempervirens. Cerasus caroliniana). Wild Mock-Orange of the South. Tree 20–40 ft. S. C. to Fla. and Tex. Cult. South and Calif.

2B Prunus ilicifolia (Cerasus ilicifolia). Wild or Evergreen Cherry. Mt. Holly. Bush or small tree to 30 ft. San Francisco to Low. Calif. and cult. South.

Prunus ilicifolia var. integrifolia. See P. Lyonii.

Prunus integrifolia. See P. Lyonii.

2B Prunus Laurocerasus (P. officinalis) in var. also (Cerasus Laurocerasus). Cherry or English Laurel. Bush or small tree to 20 ft. S. E. Eu., N. Persia. Cult. South and N. W. coast.

1BPR Prunus Laurocerasus var. schipkaensis (Cerasus Laurocerasus var. schipkaensis). This is the lowest and hardiest form of the Cherry or English laurel. The type is a bush or small tree in S. E. Eu. to N. Persia.

2B Prunus lusitanica (Padus lusitanica). Portugal Laurel. Shrub from Spain. Cult. South and West Coast to 20 ft.

2B Prunus Lyonii (P. integrifolia. P. ilicifolia var. integrifolia). Islands Cherry. Bush or small tree. Islands off S. Calif. Cult. Calif.

Prunus officinalis. See P. Laurocerasus.

1 Pseudotsuga taxifolia (P. mucronata. P. Douglasii). Douglas Spruce. Red Fir. Pyramidal tree to 200 ft. Brit. Col. to Mex. west to Mont. and Colo. Still new in the N. E. but very promising.

2BT Psidium Cattleianum. Strawberry Guava. Large Brazilian shrub. Cult. in Fla. and Calif. to 6 ft.

2BT Psidium Guajava. Guava. Arborescent shrub or small tree to 30 ft. Mex., Cent. Amer.

Ptychosperma Alexandræ. See Archontophœnix Alexandræ.

Pummelo. See Citrus grandis.

2B Pyracantha angustifolia (Cotoneaster angustifolia). Shrub to 6 ft. S. W. China. Cult. in Calif.

2B Pyracantha coccinea (Cotoneaster Pyracantha. Cratægus Pyracantha. Mespilus Pyracantha). Fire Thorn. Fiery Thorn. Everlasting Thorn. Shrub to 20 ft. Italy, W. Asia. Cult. South and N. W. coast.

1BPR Pyracantha coccinea var. Lalandii (Cotoneaster crenulata). More vigorous and hardier than the type. Cult. South and N. W. coast.

2B Pyracantha crenulata (Cotoneaster crenulata. Cratægus crenulata). Himalayas. Shrub to 6 ft., more tender than P. coccinea. Cult. W. coast.

2BT Pyrostegia venusta (Bignonia venusta). Flame-Flower. Tendril-climbing vine. Brazil. Cult. Calif. and South.

Queensland Pittosporum. See Pittosporum rhombifolium.

2B Quercus acuta (Q. Buergeri). Small tree. Rare in culture. Japan, Korea.

2B Quercus agrifolia. Shrubby tree to 50 ft. Calif.

2B Quercus chrysolepsis. California Live Oak. Tree to 50, rarely 100 ft. Ore. to Calif.

2B Quercus glauca (Cyclobalanopsis glauca). Tree to 45 ft. Japan. Cult. Calif. and South.

2BT Quercus Ilex. Holly or Holm Oak. Tree to 60 ft. S. Eu. Cult. Calif.

2B Quercus laurifolia. Laurel Oak. Semi-evergreen tree to 60, rarely 100 ft. Va. to Fla. and La.

2B Quercus myrsinæfolia (Q. Vibrayana). Tree to 50 ft. Japan. Successful South.

2B Quercus Suber. Cork Oak. Tree to 50 ft. S. Eu., N. Afr. Cult. South.

Quercus virens. See Q. virginiana.

2B Quercus virginiana (Q. virens). Live Oak. Tree to 50, rarely 70 ft. Va. to Fla. west to Mex. Rapid grower.

2B Quillaja Saponaria. Soap-bark Tree. Chilean tree. Cult. in South and Calif. to 75 ft.

2BT Raphiolepis indica (R. rubra). Indian Hawthorn. Shrub to 8 ft. S. China. Cult. South and Calif.

2BT Raphiolepis umbellata (R. japonica). Large shrub from Japan. Cult. Calif to 6 ft.

Red Bay. See Gordonia Lasianthus and Persea Borbonia.

Red-Berry. See Rhamnus crocea.

Red-Box. See Eucalyptus polyanthemos.

Red-Mahogany. See Eucalyptus resinifera.

Redwood, California. See Sequoia sempervirens.

NOTE.—Retinisporas are much used in the South.

1 Retinispora decussata (Thuja orientalis var. decussata). Dense round-headed bush, not quite hardy North.

1 Retinispora Ellwangeriana (Thuja occidentalis var. Ellwangeriana). Tom Thumb Arbor-vitæ.

1 Retinispora ericoides (Chamæcyparis thyoides var. ericoides). Dense shrub.

1 Retinispora ericoides (Thuja occidentalis ericoides). Dense broadly pyramidal or round-headed bush.

1 Retinispora filicoides (Chamæcyparis obtusa var. filicoides).

1 Retinispora filifera (Chamæcyparis pisifera var. filifera).

Retinispora juniperoides, Carr. See R. decussata.

1 Retinispora leptoclada, Hort. (Chamæcyparis thyoides var. andelyensis).

1 Retinispora lycopodioides (Chamæcyparis obtusa var. lycopodioides).

1 Retinispora meldensis (Thuja orientalis var. meldensis). Valuable for formal gardening, for rockeries, small gardens and wherever dwarf conifers are desired.

1 Retinispora obtusa (Chamæcyparis obtusa).

1 Retinispora pisifera (Chamæcyparis pisifera).

1 Retinispora squarrosa (Chamæcyparis pisifera var. squarrosa). Dense, bluish form, best known of the juvenile foliage varieties.

2B Rhamnus Alaternus. Shrub or small tree to 20 ft. S. Eu. Cult. Calif.

2B Rhamnus californica (R. oleifolia). Coffee-Berry. Shrub to 15 ft. S. Ore. and Calif. Ariz. and New Mex.

2B Rhamnus crocea. Red-Berry. Shrub to 3 ft. Calif.

2B Rhamnus ilicifolia (R. crocea var. ilicifolia). Shrub or small tree to 12, rarely 20 ft. Calif.

2BT Rhapidophyllum (Chamærops) hystrix. Blue Palmetto. Needle Palm. About 5 ft. S. C. to Fla. Safer in shade.

2BT Rhapis flabelliformis (R. Kwaniwortsik). Dense fan palm 1½–4 ft. China, Japan. Hardy in S. Calif. and S. Fla.

2B Rhapis humilis. Almost stemless. China. Hardy in S. Calif. and S. Fla.

Rhododendron amœnum. See R. obtusum var. amœnum.

1B Rhododendron arbutifolium (R. daphnoides. R. Hammondii. R. oleæfolium. R. Wilsonii, Hort.). Dense shrub to 4 ft. Cult. South.

2B Rhododendron californicum. Shrub to 8 ft. Calif. and Brit. Col.

1B Rhododendron carolinianum (R. punctatum, in part). Low compact shrub to 6 ft. N. C. This is better than the related R. minus.

1B Rhododendron catawbiense. Mountain Rose Bay. Shrub to 6, rarely to 20 ft. Mts. of Va. to Ga. Hardy to New England.

1B Rhododendron hybrids varying in size, color, and time of bloom. Temp. regions of northern hemisphere.

2B Rhododendron indicum (Azalea indica. Azalea and Rhododendron macranthum). Shrub. Japan. Cult. South and W. coast.

Rhododendron macranthum. See R. indicum.

1B Rhododendron maximum. Great Laurel. Shrub or small tree to 35 ft. Nova Scotia and Ont. to Ga.

1BR Rhododendron minus (R. punctatum, in part). Straggling shrub to 10 ft. N. C. to Ga. and Ala.

1B Rhododendron myrtifolium (R. ovalifolium. R. ovatum, Hort.). Leaves smaller and broader than R. arbutifolium.

1BP Rhododendron obtusum var. amœnum. Low much-branched shrub. Japan. Flowers magenta. The form Hinodigiri has brilliant crimson flowers.

Rhododendron punctatum. See R. carolinanum and R. minus. The former is much the better type.

2BT Rhodorhiza florida (Convolvulus floridus). Shrub to 6 ft. Canary Isls. Cult. Calif.

2B Rhus integrifolia. Shrub or small tree to 30 ft. Calif.

2B Rhus laurina. Shrub. S. and Low. Calif.

2B Rhus ovata. Shrub to 10 ft. S. Calif. to Ariz.

Rhynchospermum jasminoides. See Trachelospermum jasminoides.

2B Ribes speciosum (R. fuchsioides). Shrub to 12 ft. Calif.

Rock-Rose. See Helianthemum Chamæcistus.

2BS Rosa anemoneflora.

2BS Rosa bracteata (R. Macartnea). Macartney Rose. Climbing vine, stems procumbent. S. China. Formosa. Cult. South and Calif.

2BS Rosa lævigata (R. Camellia, Hort.). Cherokee Rose. High climbing shrub. Formosa, Japan. Naturalized in South.

1BS Rosa Wichuraiana (R. bracteata, Hort.). Memorial Rose. Prostrate creeping vine. Japan. Good for covering banks and rockeries.

Rose-Apple. See Eugenia Jambos.

Rose Bay. See Nerium Oleander.

2B Rosmarinus officinalis. Rosemary. Shrub 2–4 ft. Medit. region. Cult. Calif.

Rosemary. See Rosmarinus officinalis and Andromeda.

Rose-of-Sharon. See Hypericum calycinum.

Roystonea floridana. See Oreodoxa regia.

1BR Rubus hispidus (R. obovalis). Swamp Dewberry. Trailing vine. Nova Scotia to Ga. and Kans. Ground-cover for moist acid soil. Leaves bronze in the sun.

1BPRS Rubus. European species. Vigorous low shrubs with arching and long trailing branches.

2B Ruscus aculeatus. Butchers Broom. Shrub 1½–3½ ft. Eu., Maderia, Caucasus. Cult. Fla. and S. Calif.

Sabal Adansonii. See Sabal glabra.

2BT Sabal (Inodes) Blackburniana. Spineless palm 30–40 ft. W. Indies. Cult. Fla.

2BT Sabal (Inodes) exul. Strong vigorous tree. Mex. to Tex.

2B Sabal glabra (S. Adansonii). Dwarf Palmetto. Blue Palm. Stemless palm. Native to Southern States.

2BT Sabal mauritiæformis (S. glaucescens). Palm 60–80 ft. W. Indies.

2BT Sabal megacarpa (S. Etonia). Scrub Palmetto. Low shrub. Fla.

2B Sabal Palmetto (Inodes Palmetto). Cabbage Palmetto. Tree 20–80 ft. N. C. to Fla. and Bahamas. Cult. to 12 ft. in Calif.

2BT Sabal princeps, Hort. Large species. Habitat unknown. Cult. Calif.

2BT Sabal texana (S. mexicana. Inodes texana). Robust palm to 50 ft. S. Tex.

Sago-Palm. See Cycas circinalis.

2BT Salpichroa rhomboidea. Woody climber. Argentina. Cult. Calif. Withstands alkali soil and intense heat.

2BT Salvia Sessei (S. Roezlii). Subshrub to 1½ ft. Mex.

Sand-Myrtle. See Leiophyllum buxifolium.

Santolina Chamæcyparissus (S. incana). Lavender-Cotton. Half shrubby plant 1½–2 ft. Medit. region.

2B Sapindus marginatus. Tree to 60 ft. S. C. to Fla.

Savin. See Juniperis virginiana.

Scarlet Bush. See Hamelia patens.

2B Schinus Molle. Peruvian Mastic-Tree. California Pepper-Tree. Tree to 20 ft. Peru. Harbors scale insects. Cult. Calif.

1R Sciadopitys verticillata. Umbrella-Pine. Tree to 100 ft. Japan Cult. South.

Scorpion Senna. See Coronilla Emerus.

Scotch Broom. See Cytisus scoparius.

Sea Buckthorn. See Hipphophaë rhamnoides.

Seaforthia elegans. See Archontophœnix Cunninghamii.

Sea Urchin. See Hakea laurina.

2 Sequoia gigantea (S. Wellingtonia). California Big-Tree. Tree 150–325 ft. West Sierra Nevadas.

2 Sequoia sempervirens. California Redwood. Tree 100–340 ft. N. and cent coast ranges in Calif.

2B Serenoa serrulata. Saw Palmetto. Creeping, branching shrub 4–8 ft. North to Charleston, S. C.

2BT Serjania fuscifolia. Tall climbing shrub. Brazil. Cult. Calif.

2BT Severinia buxifolia (Atalantia buxifolia. Citrus buxifolia. Often wrongly listed as Triphasia monophylla). Severino Citrus. Spiny shrub or dwarf tree S. China. Cult. Gulf States.

Severino Citrus. See Severinia buxifolia.

Shaddock. See Citrus grandis.

Silk-Oak. See Grevillea robusta.

2B Skimmia Fortunei. Dwarfer than S. japonica. China. Succeeds in South and Calif.

2B Skimmia japonica (S. fragrantissima, Hort.). Shrub to 5 ft. Japan. Succeeds in South and Calif.

Smilax, Florida. See Smilax lanceolata.

Smilax, Florists. See Asparagus asparagoides.

2B Smilax lanceolata. Florida Smilax. Tendril climber. Va. to Fla., Ark. to Tex.

2B Smilax laurifolia. False China Brier. Southern Smilax. Tendril climber N. J. south to Fla. and Tex.

Smilax, Southern. See Smilax laurifolia.

Snowberry, Creeping. See Chiogenes.

Soap-bark Tree. See Quillaja Saponaria.

2B Sollya heterophylla. Australian Bluebell Creeper. Small shrubby twiner to 2–6 ft. Australia. Cult. South and Calif.

Sorbus glabra. See Photinia glabra.

Spanish Bayonet. See Yucca angustifolia.

Spanish Broom. See Spartium junceum.

2BT Sparmannia africana. Large shrub to 10 ft. S. Afr. Cult. Calif.

2B Spartium junceum (Genista juncea). Spanish Broom. Shrub to 10 ft. Medit. region. Cult. Calif.

Spartium multiflorus. See Cytisus multiflorus.

Spartocytisus filipes. See Cytisus filipes.

2BT Sphæralcea umbellata (S. vitifolia). Erect branched shrub to 3 ft. Mex.

Spruce, Black. See Picea mariana.

Spruce, Colorado or Blue. See Picea pungens.

Spruce, Douglas. See Pseudotsuga taxifolia.

Spruce, Engelmann. See Picea Engelmanni.

Spruce, Gregory. See Picea Abies var. Gregoryana.

Spruce, Koster Blue. See Picea pungens var. Kosteriana.

Spruce, Maxwells. See Picea Abies var. Maxwellii.

Spruce, Norway. See Picea Abies.

Spruce, Oriental. See Picea orientalis.

Spruce, Red. See Picea rubra.

Spruce, Tigertail. See Picea polita.

Spruce, White. See Picea glauca.

Spurge, Evergreen. See Pachysandra terminalis.

Spurge, Olive. See Cneorum tricoccon.

2BT Stauntonia hexaphylla. Climbing vine to 40 ft. Japan. Cult. Calif.

2BT Sterculia. See Brachychiton.

Strawberry-Tree. See Arbutus Unedo.

2BT Streptosolen Jamesonii (Browallia Jamesonii, Hort.). Shrub to 6 ft. Colombia. Cult. Calif.

2BT Strobilanthes Dyerianus. Erect branching stove shrub. Burma. Cult. Calif.

2BT Swainsona (Colutea) galegifolia var. albiflora (alba, Hort.). Climbing shrub to 6 ft. Australia. Cult. Calif.

Swamp Dewberry. See Rubus hispidus.

Swamp-Mahogany. See Eucalyptus robusta.

Sweet Bay. See Laurus nobilis and regalis and Magnolia glauca.

Sweet Leaf. See Symplocos tinctoria.

2B Syagrus campestris (Cocos campestris). Shrubby palm to 8–10 ft. Hardy north to N. C. Brazil.

Sydney Golden Wattle. See Acacia longifolia.

2B Symplocos tinctoria. Sweet-Leaf. Horse-Sugar. Half evergreen shrub or small tree to 30 ft. Del. to Fla. and La.

Tacsonia manicata. See Passiflora manicata.
Tacsonia mollissima. See Passiflora mollissima.
Tangerine Orange. See Citrus nobilis var. deliciosa.
Tawhiwhi. See Pittosporum tenuifolium.

2 Taxus baccata in variety. The type is a tree to 60 ft. Eu., N. Afr. Cult. South and N. W. coast.

2 Taxus baccata fastigiata (T. hibernica, Hort.). Irish Yew. Columnar form. Cult. South and N. W. coast.

1P Taxus baccata repandens. This is the hardiest form of the English yew. Low shrub. Eu. and N. Afr. to Himalayas. Cult. South.

1 Taxus canadensis. Ground-Hemlock. American Yew. Prostrate shrub. Newf. and Man., south to Va. and Iowa.

1 Taxus cuspidata (T. baccata var. cuspidata). Japanese Yew. The best and hardiest of all yews. Tree to 50 ft. in Japan, but more shrubby and very variable in cult.

1 Taxus cuspidata var. nana (var. brevifolia). A hardy substitute for Buxus.

2B Taxus floridana. Shrub or bushy tree to 25 ft. Fla.

1R Taxus Hicksii. A new hardy form, narrow and upright like the Irish yew.

Tea. See Thea sinensis.
Tecoma capensis. See Tecomaria capensis.
Tecoma jasminoides. See Pandorea jasminoides.

2BT Tecoma Smithii. Upright shrub. Australia. Cult. Calif.

2BT Tecomaria (Tecoma) capensis. Cape Honeysuckle. Shrub to 8 ft. S. Afr. Cult. Calif.

2BT Templetonia retusa (T. glauca). Coral-Bush. Tall shrub. Australia. Cult. Calif.

2B Ternstrœmia japonica (Cleyera japonica, Thunb.). Shrub 8–12 ft. Japan. Cult. Calif.

1BR Teucrium Chamædrys. Perennial, shrubby. Eu.

2B Teucrium fruticans. Shrub 2–3 ft. Eu. Cult. Calif. Recommended for dry places South.

Thea japonica. See Camellia japonica.

2B Thea sinensis in var. (Camellia Thea. C. theifera). Tea. Shrub or tree to 30 ft. China, Japan. Cult. South to 6 ft.

2BT Thevetia nereifolia. Trumpet-Flower. Yellow Oleander. Shrub. W. Indies, Mex. Cult. S. Fla. and S. Calif.

Thuja. See Retinispora and Chamæcyparis.
Thuja Craigana. See Libocedrus decurrens.
Thuja gigantea. See T. plicata.
Thuja japonica. See T. Standishii.

1 Thuja occidentalis in variety. Common Arbor-vitæ. White Cedar. Especially Douglasii pyramidalis, globosa, Little Gem, fastigiata, Rosenthali, Tom Thumb and the Siberian Arbor-vitæ (var. robusta or Wareana). The type is a tree to 60 ft. New Bruns. to Man. south to N. C. and Ill. Cult. South.

1P Thuja orientalis (Biota orientalis). Chinese or Eastern Arbor-vitæ in variety, especially aurea nana, elegantissima and stricta. Type a tree to 25 ft. from Persia to E. Asia, in Japan. Much cult. South.

1R Thuja plicata (T. gigantea. T. Lobbii, Hort.). Tall tree. Alaska to N. Calif. and Mont.

1R Thuja Standishii (T. japonica. Thujopsis Standishii). Tree to 20–30 ft. Japan.

Thujopsis borealis. See Chamæcyparis nootkatensis.

2 Thujopsis dolobrata (Thuja dolobrata, L.). Pyramidal tree to 50 ft. Japan. Cult. South but suffers from summer drought. Should have sheltered shady situation.

1PR Thujopsis dolobrata var. Hondai. Hardier than the type.

Thujopsis Standishii. See Thuja Standishii.

1BS Thymus Serpyllum (T. azoricus). Mother of Thyme. Creeping Thyme. Perennial or subshrubby. Eu., Asia and N. Afr.

Tinus laurifolius. See Viburnum Tinus.

2BT Tithonia diversifolia (Mirasolia diversifolia). Large shrub. S. Mex. and Guatemala. Cult. Calif.

2 Torreya californica (Tumium californicum). California-Nutmeg. Tree to 70 ft. or more. Calif

1PR Torreya nucifera. Tree 30–80 ft. Japan. Cult. South and W. coast.

2 Torreya taxifolia (Tumion taxifolium). Tree to 40 ft. Fla.

Toyon. See Heteromeles arbutifolia.

2BT Trachelospermum jasminoides (Rhynchospermum jasminoides). Star-Jasmine. Confederate-Jasmine. Climbing shrub to 3 ft. Cult. South and Calif.

2BT Trachycarpus cæspitosa. Tall palm of plumosa type.

2BT Trachycarpus excelsa (T. Fortunei. Chamærops excelsa). Fortunes Palm. Chinese Windmill Palm. China, Japan. Cult. to 20 ft. in Fla. and Calif.

2BT Trachycarpus Martiana (T. Khasiana). Slender tall plant. Himalayas, Burma, Assam. Cult. Calif.

Trailing Arbutus. See Epigæa repens.

Tree Alfalfa. See Medicago arborea.

Tree Fern. See Dicksonia antarctica and Alsophila australis.

Triphasia monophylla. See Severinia buxifolia.

2BT Tristania conferta (Lophostemon arborescens). Brisbane-Box. A tree from Queensland. Cult. to 20 ft. in Calif.

2BT Trithrinax braziliensis. Slender palm to 6–12 ft. Shade. Brazil. Cult. Calif.

2BT Trithrinax campestris. More rigid than T. braziliensis. Argentina. Shade. Cult. Calif.

Trumpet-Flower. See Bignonia capreolata.

Trumpet-Flower. See Thevetia nereifolia.

1 Tsuga canadensis (Abies canadensis). Common Hemlock. Tree to 70 ft. New Bruns. and Wis. south to Ala. This is the most graceful northern evergreen. Can easily be restrained and makes beautiful hedges.

1 Tsuga caroliniana. Carolina Hemlock. Tree to 70 ft. Va. to S. C. Still new in northern plantings but is very promising. Has proved just as hardy as T. canadensis and is even more graceful.

1PR Tsuga diversifolia (Abies diversifolia). Tree. Japan.

2 Tsuga heterophylla (T. Albertiana. T. Mertensiana, Carr.). Tree to 200 ft. Alaska to Calif., west to Mont.

2 Tsuga Mertensiana, Sarg. (T. Pattoniana. T. Hookeriana). Tree to 100 ft. B. C. to Calif., west to Mont.

1R Tsuga Sieboldii (T. Araragi). Tree. Japan.

Tumion. See Torreya.

Turks Turban. See Clerodendron Siphonanthus.

Twin-Flower. See Linnæa borealis.

Ugni. See Myrtus Ugni.

2B Ulex europæus. Furze. Gorse. Whin. Spiny shrub to 3–5 ft. W. and S. Eu. Cult. South and N. W. coast.

2B Umbellularia californica (Oreodaphne californica). California Laurel. Handsome small tree about 30 ft. Calif.

1BR Vaccinium macrocarpon (Oxycoccus macrocarpus). Large or American Cranberry. Low shrub to 1–4 ft. N. N. Amer.

2B Vaccinium ovatum. Erect rigid shrub 2–8 ft. Vancouver to Monterey, Calif. Cult. W. coast.

1BR Vaccinium Oxycoccus (Oxycoccus Oxycoccus). Small Cranberry. Low shrub to 4–10 in. Sphagnum swamp in subarctic and alpine regions of Old and New World.

1BR Vaccinium Vitis-Idæa (Vitis-Idæa Vitis-Idæa). Mountain Cranberry. Cowberry. Foxberry. Low shrub 6–10 in. Arctic region, to the coast and mts. of New England, Minn. and Brit. Col.

2B Veronica buxifolia. New Zeal. Shrub. Cult. Calif. to 3 ft.

2B Veronica carnea. New Zeal. Shrub. Cult. Calif. to 6 ft.

2B Veronica cupressoides. New Zeal. Shrub. Cult. Calif.

2B Veronica elliptica (V. decussata). Small tree from S. Amer. and New Zeal. Cult. Calif. as shrub to 8 ft.

2B Veronica Hulkeana. New Zeal. Shrub. Cult. Calif. 1–3 ft.

2B Veronica speciosa (V. imperialis, Hort.). New Zeal. Shrub. Cult. Calif. to 6 ft.

2B Veronica Traversii. Small New Zeal. shrub. Cult. Calif.

Vetch, Crown. See Coronilla.

2B Viburnum odoratissimum (V. Awafuki, Hort.). Upright shrub to 10 ft. India to S. China and Japan. Tender.

1BPR Viburnum rhytidophyllum. Shrub to 10 ft. Cent. and W. China.

2B Viburnum suspensum (V. Sandankwa). Shrub to 6 ft. Liu-kiu Isl. Cult. South and Calif.

2B Viburnum Tinus (V. Laurustinus, Hort. Tinus laurifolius). Laurustinus. Shrub to 10 ft. Medit. region. Cult. both South and W. coast.

Victorian-Box. See Pittosporum undulatum.

2B Vinca major. Larger than V. minor. Eu. Cult. South and N. W. coast.

1B Vinca minor. Periwinkle. Myrtle. Creeping plant. Eu., also commonly cult. South and West.

Viscum flavescens. See Phoradendron flavescens.

Vitis antarctica and capensis. See Cissus.

Vitis-Idæa. See Vaccinium Vitis-Idæa.

2BT Washingtonia filifera var. robusta (W. filifera, Hort.). Palm to 60–90 ft. Borders of Col. desert in S. Calif. Fairly tolerant of alkali soil. Cult. in Fla. and Calif.

2BT Washingtonia gracilis (W. robusta, Hort.). Slender palm to 80 ft. in the North. Low. Calif. Cult. Fla. and Calif.

2BT Washingtonia Sonoræ (Neowashingtonia Sonoræ). Palm to 25 ft. Guyamas and Low. Calif. and Mex. Cult. Fla. and Calif.

Wax-Myrtle. See Myrica cerifera.

Wax-Plant. See Hoya carnosa.

Whin. See Ulex europæus.

Wild Mock-Orange. See Prunus caroliniana.

Wild or Evergreen Cherry. See Prunus ilicifolia.

Wine Palm of Chile. See Jubæa spectabilis.

Wintergreen. See Gaultheria procumbens.

Wintergreen, Spotted. See Chimaphila maculata.
Wire-Plant. See Muehlenbeckia complexa.
Wonga-Wonga Vine. See Pandorea australis.
Woodwax. See Genista tinctoria.

Xolisma ferruginea. See Lyonia ferruginea.

Yaupon. See Ilex vomitoria.
Yellow Oleander. See Thevetia nereifolia.
Yew, American. See Taxus canadensis.
Yew, English. See Taxus baccata.
Yew, Irish. See Taxus baccata var. fastigiata.
Yew, Japanese. See Taxus cuspidata.

2B Yucca aloifolia (Y. serrulata). Low shrub with narrow dagger-like leaves arising in a dense rosette from the underground stem. W. Indies and New Mex. to Va.

1B Yucca angustifolia (Y. glauca). Bear-Grass. Spanish Bayonet. Low shrub with narrow dagger-like leaves arising in a dense rosette from the underground stem. S. Dak. to New Mex.

1B Yucca filamentosa. Adams Needle. Low shrub like the above, but leaves are broader and more sword-like.

1B Yucca glauca. See Y. angustifolia.

2B Yucca gloriosa (Y. acuminata). Foliage resembles that of the other yuccas, but plant becomes bushy by developing a short trunk. Coast from S. C. to Fla.

2B Yucca Treculeana (Y. contorta, cornuta, Hort.). Foliage resembles that of the other yuccas, but plant becomes a small tree with distinct trunk. Texas to E. Mex.

2BT Zamia floridana. Coontie. Comptie. Fern-like plant. S. Fla. in open dry pine woods.

1BRS Zenobia pulverulenta (A. glauca, Hort.). Shrub 2–4 ft. N. C. to Fla. Has beautiful glaucous leaves and stems.

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